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ABSTRACT

This volume is the second of two volumes reporting a study performed for the Manpower Development Staff (Planning and Special Projects Section) of the Environmental Protection Agency. Volume 1 of the report covers Phase 2 of the project, which involved description of the training curriculum presently offered by the Air Pollution Training Institute within the Control Programs Development Division. The present volume describes the development of recommendations for modifying the Air Pollution Training Institute curriculum to better meet the air pollution-training needs of the public and private sectors. The major portion of this report is dedicated to the presentation of these recommendations. An appendix is included. (Author/BT)

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Final Report

Air Pollution Training Institute Curriculum Description and Recommendations

Volume II. Curriculum Recommendations

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EDUCATION & WELFARE
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INTRODUCTION

This volume is the second of two volumes reporting a study performed for the Manpower Development Staff (Planning and Special Projects Section) of the Environmental Protection Agency (EPA). The project was conducted under Contract No. 68-02-0608 by Applied Science Associates, Inc., (ASA).

Volume I of the report covers Phase II of the project, which involved description of the training curriculum presently offered by the Air Pollution Training Institute (APTI) within the Control Programs Development Division.

The present volume describes the development of recommendations for modifying the APTI curriculum, to better meet the air pollution-training needs of the public and private sectors. The major portion of this volume is dedicated to the presentation of these recommendations, which represent Phase III of the project.

The conduct and results of the Phase I effort are presented elsewhere*. (Phase I involved analysis of the air pollution control-related tasks in the private sector.)

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*Dueker, R. L., Rifkin, K. I., & Covert, A. W. Analysis of air pollution control-related tasks in the private sector. Volume I: Conduct of the analysis. Volume II: Results of the analysis. Valencia, Pa.: Applied Science Associates, Inc., March 1973.

DEVELOPMENT OF THE RECOMMENDATIONS

The objective of the Phase III effort was to identify and describe modifications to the current APTI curriculum, based on consideration of public-sector and private-sector task-analysis findings, and on evaluation of current training. As noted above, the private sector (industry) was task-analyzed and reported in Phase I of the present project. The public sector (air pollution control agencies) was analyzed and reported as part of a previous contract (EPA Contract No. 68-02-0306)*.

The derivation of curriculum recommendations involved three major activities:

1. Identification of Public- and Private-Sector Training Needs
2. Development of Preliminary Recommendations
3. Development and Presentation of Final Recommendations

Each of these activities is detailed in the subsections which follow.

Identification of Public- and Private-Sector Training Needs

The first step in the development of curriculum recommendations was to identify the skill and knowledge training needs, both of personnel in air pollution control agencies and of persons engaged in air pollution control-relevant activities in industry. The key to developing effective recommendations lay in analyzing the respective task-analysis findings using an approach which best reflected the ultimate use toward which APTI training is directed. It was determined, based on initial review of the curriculum, that APTI training has two basic emphases:

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*Rifkin, K. I., Dueker, R. L., Diggins, W. F., Foss, F. C., & Senew, M. Task analysis of state and local air pollution control agencies and development of staffing guidelines. Valencia, Pa.: Applied Science Associates, Inc., July 1972.

1. It is Task-Centered--training is directed toward the tasks or activities performed by agencies (e.g., inspection, permit review, stack testing, laboratory analysis).
2. It is Occupational Category-Centered--training is directed toward various types of people (e.g., chemists, engineers) in the agencies, providing them with the skills and knowledge to perform the tasks typically required of them.

To be most useful for developing recommendations, therefore, the skills and knowledge making up the public- and private-sector training needs would have to be summarized both from the task-centered and occupational category-centered points-of-view. The training-needs identification was performed independently for the public and private sector data.

Identification of Public-Sector Training Needs

The public-sector task analysis had provided three basic outputs useful in the determination of training needs:

1. A listing of representative tasks performed by air pollution control agencies
2. The skill and knowledge requirements for each task
3. The occupational category of persons typically performing (or capable of performing) each task. The occupational category described the general background (e.g., mechanical engineer, bachelor's-level chemist, high-school-level technician) of the task incumbent.

No further data manipulation was necessary to isolate the skills and knowledge comprising the task-centered training needs, since the task-analysis data was organized by task. The first two basic task-analysis outputs could be used without modification. To derive occupational-category training needs, however, it was first necessary to summarize skills and knowledge across tasks typically performed by a given occupational category, as defined in the public-sector task analysis*. The resulting training-needs descriptions provided a listing of all skills and knowledge required by each occupational category within an agency. In addition, skills and knowledge common to more than one occupational category were summarized and documented.

Identification of Private-Sector Training Needs

The private-sector task analysis was also examined and summarized from both the task and occupational-category points-of-view. However, the process of generating the training needs was complicated by the need to first:

1. Define Air Pollution Control-Relevant Training Needs. Unlike the public sector, where all tasks and their skill and knowledge requirements were assumed to be air pollution training-relevant, certain tasks and skills and knowledge in the private-sector task analysis could not be so considered. The tasks and functions included in the private-sector task analysis were selected by ASA and APTI *a priori*, based on a rational analysis of the private sector. The task analysis then described each of its included tasks without regard for air pollution-training relevance. One purpose of the training needs analysis was to select air pollution training-relevant tasks and skills and knowledge in the private sector. Once this activity was accomplished, the remaining tasks and their modified skill and knowledge lists could be used as training-needs data for task-centered analysis.
2. Define Occupational Categories. The private-sector task analysis performed in Phase I did not result in the derivation of occupational categories (although

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*Ibid., pp 42-74

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the required data had been collected). The private-sector occupational categories were formally defined prior to further analysis, using the occupation-descriptive data provided by the private-sector respondents. Once the occupational categories were defined, private-sector occupational-category training needs descriptions were developed in the same manner as those derived from the public sector.

A description of the development of air pollution control-relevant skills and knowledge, tasks, occupational categories, and training needs is provided in the Appendix.

Development of Preliminary Recommendations

After public- and private-sector task-centered and occupational category-centered training needs were specified, preliminary recommendations were structured. This activity can be described in four steps:

1. Development of Objectives for the Recommendations
2. Development of General Recommendations
3. Development of Course-Specific Recommendations
4. Review of Preliminary Recommendations

Development of Objectives for the Recommendations

Having completed the description of the APTI curriculum in Phase II and the training needs analyses, ASA project staff were sufficiently familiar with all the data inputs (i.e., the task-analyses contents, course descriptions, and general curriculum descriptions) to define what types of recommendations would be most useful to APTI. It was determined, based on preliminary review of the data, that both general and course-specific recommendations should be made.

General-level recommendations would suggest modifications in overall curriculum philosophy and course-development approach. The objectives of general-level recommendations would be to:

1. Reflect the state-of-the-art in training development techniques as derived from ASA's technical training experience.
2. Represent a practical and implementable improvement over present practices, based on consideration of APTI operating constraints (e.g., APTI's mission, available funds, instructor availability, current staff skills).

Course-specific recommendations would suggest changes in the content and structure of each individual course. The aims for the course-specific recommendations are listed below, in approximate decreasing order of priority:

1. Reflect in the APTI courses the skills and knowledge required to effectively perform agency tasks and agency occupational-category roles, to the extent that the skills and knowledge are not already included. The decision on addition or deletion of a course skill or knowledge must be based on consideration of the following facts:
    a. The task-analysis findings were derived from a sample of agencies. Thus, a given skill or knowledge (or task) may not be common to all agencies. Such a skill or knowledge or task should be included in training only when it is judged to occur in most agencies.
    b. Some of the skills and knowledge may not be practically trainable (e.g., interpersonal relations skills). Skills and knowledge questionable in this regard must be further analyzed to determine which, if any, of their component parts could be trained within APTI,

as APTI is presently structured. These practically trainable skill and knowledge component parts could be recommended for inclusion in a course. For example, while training a person how to be tactful might not be practical in a given course, it might be possible to train knowledge of another person's point-of-view (i.e., train a component part of the skill of being tactful).

c. Some tasks may be infrequently performed or extremely simple and thus not cost-effective to train. Such tasks, and the task-unique skills and knowledge associated with them, should not be included in training.

2. Minimize the number of courses required to provide skills and knowledge for a given occupational category or agency activity. Individual course content was to be modified to reduce to a minimum the number of courses agency personnel need attend to learn performance of a given task or occupational role.

3. Minimize course-content overlaps to the extent possible, without substantially increasing the number of courses necessary to cover the required content. This would include reducing the amount of basic review material provided in advanced courses.

4. Specify prerequisite skills and knowledge for each course, and identify methods to be used by the student to:

   a. Determine his qualifications for the course (e.g., through published lists of skill and knowledge prerequisites, or student self-administered and self-evaluated pretests).

   b. Satisfy the prerequisites (e.g., through reading lists, self-administered packaged courses, or formal APTI courses).

5. Maintain the general structure of the APTI curriculum, current and planned, wherever possible. Planned curriculum changes (e.g., course packaging, course additions, and course deletions) were to be reviewed and integrated into the proposed course modifications, to the extent that they were judged appropriate.

6. Make recommendations for changes which are consistent with the resources available to APTI for implementing them.

7. De-emphasize lecture in formal courses in favor of instructional approaches offering more student control of pacing and more two way communication.

8. Increase emphasis on packaging, so as to:

    a. Permit conduct of the course at regional training centers by non-content-expert instructors

    b. Increase ability of the student to structure his learning around his unique needs

    c. Permit several personnel levels (e.g., chemists and chemistry technicians) to efficiently use the same course

    d. Free instructors to assist students on an individual basis.

9. Provide for a flexible curriculum which will fulfill the training needs of a variety of personnel in agencies organized in a variety of ways (e.g., large versus small agencies).

10. Take into account the air pollution-relevant task-centered and occupational category-centered training needs of the private sector. Include private sector-relevant skills and knowledge in course content, to the extent that this will not prejudice the effectiveness and acceptability of the courses for public sector trainees.

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Development of General Recommendations

General recommendations (i.e., those concerned with APTI training philosophy and course development) were derived from an analysis of (a) the general training description developed in Phase II (see Volume I), and (b) the faculty interviews from which the general training description was produced. The ASA project staff operated as a team to review the data and develop, discuss, critique, modify, and agree on a set of general recommendations to satisfy the objectives stated above. Recommendations were generated in the following areas:

1. Training philosophy and methods
2. The determination of training needs
3. Organization of training
4. Specification of training goals
5. Specification of training objectives
6. Specification of student/instructor activities
7. Evaluation of student performance
8. Course documentation
9. Specification of student population
10. Development and use of prerequisites
11. Use of pretests.

Development of Course-Specific Recommendations

At the same time that general recommendations were being drafted, work proceeded on the much larger task of developing recommendations for individual courses and coordinating the content and structure of the modified courses into an integrated curriculum. Data inputs employed in the development of the course-specific recommendations were:

1. Individual course descriptions, and the course materials and interview data from which they were derived.
2. Public-sector task descriptions and skill and knowledge lists.

3. Public-sector occupational-category training needs descriptions.

4. Private-sector task descriptions and skill and knowledge lists, modified to reflect air pollution relevance.

5. Private-sector occupational-category training needs descriptions, modified to reflect air pollution relevance.

The development of recommendations was basically a trial-and-error process, involving repeated comparison and reexamination of the data inputs by the ASA project team. Recommendations were developed, critiqued, and revised in an attempt to best fulfill the objectives.

Preliminary Course Modification Recommendations Statements were written describing 23 courses. Five new courses were recommended. These 28 courses covered, with minor exceptions, the content offered in 30 of the 39 APTI courses offered in fiscal year 1972. Preliminary recommendations were not developed for the remaining nine courses, for the following reasons:

1. Four courses (440, 441, 442, and Special Training in Surveillance and Laboratory) are Special Topics courses in the various instructional sections of APTI, and have no fixed content.

2. Four courses (422-B, 422-C, 461, 462) are under development, and little information is available concerning their ultimate content.

3. The remaining course (454) was not sufficiently well documented at the time the preliminary recommendations were prepared to determine its content and its usefulness to agency personnel.

Seven areas of recommendations were covered in the Recommendations Statements prepared for existing and new courses:

1. Intended audience

2. Course intent

3. Course goals
4. Course structure/methodology
5. Course length
6. Course prerequisites
7. Short-term course improvement.

Recommendations for short-term course improvements were designed to define course inprovements that could be implemented during fiscal year 1973, either as an end in themselves or in preparation for carrying out longer-range recommendations (e.g., packaging).

Review of Preliminary Recommendations

The completed preliminary general recommendations and course-specific recommendations were presented to the Project Officer and to APTI instructional and instructional-development Section Chiefs. Discussions were held to clarify and amplify the various recommendations, and obtain feedback from APTI concerning:

1. The accuracy of the rationales upon which the recommendations were based
2. The extent to which the recommendations were practical and implementable within APTI
3. Additional information that might be useful for further development of the recommendations.

Development and Presentation of Final Recommendations

The data provided by the review of the preliminary recommendations was the major input to the development of the final form of the general and course-specific recommendations. The final development process for the recommendations had two basic objectives:

1. To revise the recommendations, in light of the feedback provided by APTI personnel

2. To amplify the recommendations, principally by the inclusion of skill and knowledge recommendations for individual course content and prerequisites.

To facilitate the interpretation and use of the course-specific recommendations, they were reformatted into a Recommended Course Description similar to that used for the original course descriptions (see Volume I). Each Recommended Course Description provides recommendations in seven areas:

1. General course description
2. Intended audience
3. Course goals
4. Skill and knowledge coverage
5. Course frequency
6. Course length
7. Prerequisites.

Final recommendations were developed for a total of 29 courses, including 26 existing courses and 3 new courses. Two of the five new courses originally proposed were eliminated. The content of one, "Legal Aspects for Management Personnel," was included in existing management courses. The other course, a basic laboratory-skill development course for chemistry laboratory technicians, was eliminated because it was determined that other adequate sources (e.g., technician schools operated by professional organizations) now exist for providing such training. The content of one new course (Course 1) was expanded to include maintenance of laboratory equipment.

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GENERAL RECOMMENDATIONS

Introduction

The fifteen recommendations presented in this segment of the report were developed to suggest changes in the general (1) training philosophy and methods, (2) course development, (3) student evaluation, (4) course documentation, (5) student population specification, and (6) prerequisites and the use of pretests. In the following discussion, there is a summary of the current approach in each of the six areas, followed by specific recommendations. Each recommendation includes a discussion of what the recommendation is intended to imply. The general recommendations are:

Training Philosophy and Methods

Recommendation 1. Adopt a task-oriented philosophy rather than the present liberal-arts philosophy.

Recommendation 2. Develop student-centered training.

Course Development

Recommendation 3. Arrange for course development.

Recommendation 4. Specify course intent.

Recommendation 5. Specify course goals as an early step in course development.

Recommendation 6. Specify behavioral objectives after course goals are defined, and as a part of course development.

Recommendation 7. Organize courses around behavioral objectives within modules.

Recommendation 8. Determine the activities in which the student will be involved, and what the instructor(s) will be doing to aid the student's progress.

Student Evaluation

Recommendation 9. Prepare an evaluation philosophy for each course, indicating whether and how evaluation is to be carried out.

Recommendation 10. Develop evaluation instruments appropriate to the desired goals and objectives.

Documentation

Recommendation 11. Document course-development decisions as they occur.

Recommendation 12. Periodically review the documentation, including the ongoing course files, to identify needs for revision and updating of both the course and its documentation.

Student Population Specification

Recommendation 13. Define the student population for which each course is intended.

Prerequisites and Pretests

Recommendation 14. Specify prerequisite skills and knowledge, and (when appropriate) the course(s) needed to provide them.

Recommendation 15. Consider developing self-administered pretests to preview course coverage and to indicate need for prerequisite skills and knowledge.

Training Philosophy and Methods

The current APTI training philosophy is to provide advanced university-like courses in various facets of air pollution control. The guiding principle within the curriculum is to provide a "liberal arts" (i.e., a broad, general) coverage of the subject fields included in the larger field of air pollution control. The use of advanced courses implies that they are aimed at professional-level personnel having at least a bachelor's degree in some appropriate career field. Training is essentially instructor-centered and instructor-controlled.

Recommendation 1: Adopt a Task-Oriented Philosophy Rather than the Present Liberal-Arts Philosophy

Task-oriented training focuses on teaching specific tasks needed by the trainee, either individually or in groups having similar needs. Following a task-oriented philosophy minimizes the use of training time for presenting material not clearly needed by the trainee.

Recommendation 2: Develop Student-Centered Training

Student-centered training implies active trainee participation in the training effort. Instructional staff must organize the training content and make provisions for meaningful learning exercises, but the trainee should actively participate in the learning. Ways to provide student-centered training would be:

1. More use of existing small-group exercises, but with better-defined goals
2. Arrangements for active student control of exercises
3. More use of existing individual exercises, with the exercises rewritten to be self-administered.

Course Development

Currently, course development takes place as an auxiliary activity by instructional staff. The Control Programs Development Division philosophy is that the most productive use of instructional staff time is in the classroom.

Typically, course development proceeds in the often-fragmented available time of the assigned Course Director, in this general sequence:

1. Course intent is determined, and a brochure description is developed.
2. Course content is collected, and possible modes of presentation are considered and tenatively determined.
3. For the first scheduled course presentation, as many presentation modes and support materials as possible are produced, including lectures, audiovisual presentations, manuals, etc.
4. The course is presented, and the materials and presentation modes are carefully evaluated for their degree of success.
5. Any or all of the above steps are recycled until the course is successfully stabilized (i.e., until the course is judged to require no important further changes).

Recommendation 3: Arrange for Course Development

The instructional staff must be given sufficient uninterrupted time for course development activities if curriculum changes and adequate course development are to be conducted. Approximately one-third of the instructor's time could be profitably spent in course development (including modification of existing courses).

Recommendation 4: Specify Course Intent

As a first step in course development, a specific definition of course intent should be documented to provide a statement of the course's major purpose(s), the level of its instructional approach, and the basic mode(s) of instruction. The basic course intent for existing courses can be inferred from brochure descriptions.

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Recommendation 5: Specify Course Goals as an Early Step in Course Development

A list of course goals focuses course development on what the outcomes are to be for the trainee. This listing should be prepared early in course development, rather than derived from the course after it is in existence. To determine course goals, examine the course intent. Decide what the trainee would have to know and be able to do, in order to fulfull course intent to the level specified.

Recommendation 6: Specify Behavioral Objectives After Course Goals are Defined, and as a Part of Course Development

Behavioral objectives (i.e., those behaviors that the training is to induce) are essentially an operational definition of a goal. To reach each goal, the trainee must exhibit certain behaviors, to a specified performance standard. If, upon examination, the exhibition of the behaviors implicit in a goal proves to be trivial or inappropriate, reexamine the goal.

When behavioral objectives are specified as a part of course development to define a goal, they provide a blueprint for the course. If specification of behavioral objectives comes *after* course development, the result is typically to focus on making a list of the behaviors currently exhibited by trainees taking the course. Objectives derived in this manner are not only difficult to produce but are of limited value, because they do not necessarily relate to course goals.

Recommendation 7: Organize Courses Around Behavioral Objectives Within Modules

To organize the developing course, the course goals and their accompanying behavioral objectives are arranged into a logical presentation sequence. Examination is then made of both the objectives and the skills and knowledge that the trainee must gain to meet those objectives. A training module may be made up of all the skills and knowledge required to meet one objective. However, some skills and knowledge may be required for more than one objective, and in this case a module providing training of these common skills and knowledge would be more useful. A third kind of module could then be defined, providing training in the objective-specific skills and knowledge, without the common ones described above. The delineated modules can be organized as appropriate to the determined presentation sequence.

Recommendation 8: Determine the Activities in Which the Student Will Be Involved, and What the Instructor(s) Will Be Doing to Aid the Student's Progress

At this point in course development, the course intent, goals, and objectives have been determined, and training modules have been defined. The next step is to decide what student activities will most effectively aid the student toward meeting the objectives. The process implied is typically carried out by developing Programs of Instruction (POI) and lesson plans. It is important that this step be actually carried out, and that it be done at this stage of course development.

Student Evaluation

Student evaluation is currently carried out in a more-or-less formal manner, with no documented rationale for what is done. Trainee evaluation for individual courses is frequently on the basis of (1) trainee success in doing assigned exercises, (2) instructor observation of the trainee's skill in performing procedures, and/or (3) conventional tests or quizzes. The standards or criteria for those evaluation methods are often not specified.

Recommendation 9: Prepare an Evaluation Philosophy for Each Course, Indicating Whether and How Evaluation is to be Carried Out

It is important to specifically decide whether student evaluation is necessary at all. In cases where evaluation is necessary, determine the purpose of the evaluation:

1. To test student performance for formal records

2. To sample student achievement for assessing progress or non-progress.

More than one type of evaluation method may be desirable. Evaluation methods include:

1. Traditional tests of recall and/or demonstration of verbal knowledge
2. Instructor observation and judgment
3. Performance of exercises to a specified standard
4. Student self-administered progress and/or review checks
5. Combination methods.

Decisions on whether or not to evaluate, and how to evaluate, should be documented[*].

Recommendation 10: Develop Evaluation Instruments Appropriate to the Desired Goals and Objectives

Once an evaluation philosophy has been determined, the tests, rating sheets, performance standards, exercises, etc., must be produced. The instruments developed must reflect the defined behaviors, as specified in the objectives. (It is of doubtful value to have on record that the student knows the name of a reference method, when what is really desired is for the student to exhibit an ability to use the method, and analyze an unknown sample.) Performance criteria (i.e., what constitutes successful performance) must be documented for each task item. Where pass/fail judgments must be made, defendable cut-off scores must be determined.

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[*] It is advisable to plan evaluation so as to permit evaluating the effectiveness of the various course modules, as well as evaluating the trainee.

Documentation

Course documentation is currently provided in two distinct forms. One form, the course-summary notebook, provides what might be considered raw data about the ongoing course. This notebook is a file, containing the student materials and critiques for each course presentation.

A second file of course documentation, containing course objectives, developmental decisions, lesson plans, and POIs, is often incomplete and at least partially outdated.

Recommendation 11: Document Course-Development Decisions as They Occur

Documentation should keep pace with course development, so that final decisions on course intent, course goals, behavioral objectives, student and instructor activities, and evaluation philosophy are all on record at the time the course is presented.

Recommendation 12: Periodically Review the Documentation, Including the Ongoing Course Files, to Identify Needs for Revision and Updating of Both the Course and Its Documentation

To keep documentation current, it must be updated to reflect input from student critiques, changing needs, revision of intent or objectives, changes in activities or evaluation, and changes in the state-of-the-art.

Student Population Specification

The general intended audience for each course is currently specified in terms of occupational or professional group.

Recommendation 13: Define the Student Population for which Each Course is Intended

A definition of student population should specify all the characteristics assumed for the students for whom the course is being developed. With a broad audience, there may be only a few basic characteristics that can

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be assumed. Characteristics of the student population that might be specified are:

1. Educational background, in general and in topic-related areas
2. Level of comprehension
3. Reading level.

Specifying assumptions about the student population characteristics makes it more likely that the course will actually be developed for the intended audience.

For efficient instruction, the content, pace, and methods of presentation employed should be those appropriate to the lowest level of trainee in the intended audience. However, it is equally important to avoid structuring the course below the lowest level for which it is intended.

Prerequisites and Pretests

Brochure descriptions provide a listing of recommended or required prerequisites for each course. Pretests are frequently administered at the beginning of a formal course. The rationale for and actual purpose of the pretests is often not specified.

Recommendation 14: Specify Prerequisite Skills and Knowledge, and (When Appropriate) the Course(s) Needed to Provide Them

Courses requiring specialized skills and/or knowledge, such as a certain vocabulary or specific math skills, should list those prerequisites in the course description. In addition to the list of prerequisite skills and knowledge, indications of how they can be gained should be included where possible. Sources may include books, articles, and reports; APTI formal or packaged courses; and/or courses available elsewhere.

Recommendation 15: Consider Developing Self-Administered Pretests to Preview Course Coverage and to Indicate Need for Prerequisite Skills and Knowledge

A pretest is a useful device for deciding whether prospective students have the prerequisite skills and knowledge necessary for successful completion of a course. Self-administered pretests are helpful to the Institute, because they place the responsibility for determining student qualifications for a course upon the student himself, and require no faculty time after development.

COURSE-SPECIFIC RECOMMENDATIONS

This section contains recommended course modifications for 26 existing APTI courses and descriptions of three new courses. The recommendations are presented separately by course. The courses are grouped according to the APTI section responsible for them. Each section is tabbed to facilitate reference. The grouping of the courses by APTI section is as follows:

1. Instructional Development

    422-A Air Pollution Control

2. Surveillance and Laboratory

    435 Atmospheric Sampling

    436 Determination and Measurement of Atmospheric Metals

    429 Gas Chromatographic Analysis of Air Pollutants

    464 Analytical Methods for Air Quality Standards

    465 Determination of Polycyclic Aromatic Hydrocarbons

    420 Air Pollution Microscopy

    405 Sampling and Identification of Pollen and Fungus Spore Aero-Allergens

    448 Effects of Air Pollution on Vegetation

    411 Air Pollution Meteorology

    447 Meteorological Instrumentation in Air Pollution

    463 Air Quality Monitoring Systems

    423 Diffusion of Air Pollution - Theory and Application

    1 Maintenance of Laboratory Equipment

3. Engineering and Enforcement

   801 Basic Environmental Statistics

   426 Statistical Evaluation of Air Pollution Data

   444 Air Pollution Field Enforcement

   439 Evaluation of Visible Emissions

   431 Air Pollution Control Technology

   413 Control of Particulate Emissions

   415 Control of Gaseous Emissions

   427 Combustion Evaluation

   450 Source Sampling

4. Air Quality Management

   452 Principles and Practice of Air Pollution Control

   456 Regional Planning and Air Quality

   457 Public Communications

   458 Air Pollution Administration

   2 Air Quality Program Development

   3 Presentation of Expert Testimony

The recommendations for each course are provided in the form of a modified course description. Seven areas of recommendations are delineated:

1. General course description, including modifications in course intent; in major instructional concepts (e.g., packaging, use of self-instructional media, modularization); and in instructor characteristics or role. The general course description will provide a summary of the major ways in which the modified course differs from the original, and miscellaneous course-descriptive information.

2. Intended audience, describing the occupational category or categories and activities toward which the course is directed.

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3. Course goals, indicating the general aims of the course.
4. Skill and knowledge coverage, listing the skills and knowledge covered by the course, the level to which each is taught, and notes concerning appropriate instructional media.
5. Course frequency, giving recommendations concerning scheduling the course.
6. Course length, noting the time required to present the course or major subparts of the course, as modified.
7. Prerequisites, providing information of three types:
    a. Skills and knowledge prerequisite to taking the course
    b. Other (modified) APTI courses which should be taken prior to the course
    c. Suggested means of meeting the prerequisites, other than through attending formal APTI courses.

It should be noted that the modified course descriptions may occasionally recommend a change which is already in the process of being implemented by APTI. These infrequent occurrences are unavoidable due to the lack of complete and detailed descriptive data concerning a few courses and the fact that APTI courses are continually being developed and modified.

Table 1 illustrates how the modified courses or sequences of courses can meet various training requirements, given trainees of specified backgrounds. This table can serve as a guide to examining the usefulness of a given course for a specific application.

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Table 1

Summary of Modified APTI Courses Meeting
Various Training Purposes and Trainee Backgrounds

Trainee Background[1]	Training Purpose	Recommended Course or Sequence of Courses[2]			
Chemist (Public or Private Sector)	Supervise/perform typical sampling and analysis activities	435	436, 429, 464, and/or 465		
	Supervise laboratory support tasks	447	435	436, 429, 464, and/or 465	
	Supervise/perform specialty sampling and analysis activities	405	420		
Chemist (Public Sector) or Meteorologist (Public Sector or Consultant)	Design air monitoring facility	435	436, 429, 464, and/or 465	447	463
	Prepare data from continuous monitoring installation for computerized analysis	801	426		
Meteorologist (Public Sector or Consultant)	Perform short-term forecasting	411 (Level 1)			

Table 1 (continued)

Trainee Background	Training Purpose	Recommended Course or Sequence of Courses		
	Utilize modeling techniques	801	426	423
Field Enforcement Officer or Agricultural Extension Personnel	Recognize vegetation damage caused by air pollution	448		
Chemical Laboratory Technician (Public or Private Sector)	Perform typical sampling and analysis activities	422-A	435	436, 429, 464, and/or 465
	Perform specialty sampling and analysis activities	405	420	
Equipment Technician (Public or Private Sector)	Maintain laboratory equipment	422-A	1[3]	
	Operate/maintain analyzers	1[3]		
	Operate/maintain samplers and continuous monitoring equipment	1[3]		

Table 1 (continued)

Trainee Background	Training Purpose	Recommended Course or Sequence of Courses		
	Operate/maintain meteorological instrumentation		447	
Meteorological Technician (Public Sector)	Assemble meteorological data and describe climatological conditions	411 (Level 2)		
Non-Meteorological	Knowledge of the relationships between meteorology and air pollution	422-A (Meteorology Module)	411 (Level 2)	
Non-Engineer	Knowledge of control principles and devices at greater detail than 422-A or 452	431 (Level 1)		
Non-Engineer	Perform routine inspections	431 (Levels 1 & 2)	444	439

Table 1 (continued)

Trainee Background	Training Purpose	Recommended Course or Sequence of Courses		
Engineer (Private Sector)	Design control systems	413, 415, and/or 427	444	439
Engineer	Plan review evaluation	413, 415, and/or 427	444	439
Engineer or Chemist (Public or Private Sector)	Plan/supervise source testing	450 (Levels 1 & 2)		
	Act as test observer	450 (Level 1)		
Engineering Technician (Public or Private Sector)	Conduct stack testing	422-A	450 (Levels 2 & 3)	
All Agency Professional Staff	Develop basic orientation to air pollution topics and agency functioning	422-A	452	

Table 1 (continued)

Trainee Background	Training Purpose	Recommended Course or Sequence of Courses		
Public Information Specialist	Perform agency public relations/develop and coordinate agency's public statements	422-A	452	457
Agency Professional Staff	Perform in the role of technician or higher-level management	422-A	452	458[4]
Agency Professional Staff	Influence concern for air pollution in urban and transportation planning/critique impact statements	422-A	456[5]	
Urban and Transportation Planning Agency Personnel	Develop impact statements	456[5]		

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Table 1 (continued)

Trainee Background	Training Purpose	Recommended Course or Sequence of Courses		
Program Planning and Development Specialist	Develop air quality control programs and regulations	422-A	452	2[3]
Agency Professional Staff	Ability to gather and critique evidence/act as an expert	3[3]		

[1] Trainees are from Air Pollution Control Agencies unless otherwise indicated.

[2] 422-A is recommended for all new hire agency personnel. It is indicated in the table only when it is a formally required prerequisite.

[3] Proposed new course.

[4] Combines present courses 458, 459, and 460.

[5] Combines present courses 455 and 456.

Introduction to Instructional Development Section

Course administration is not a major activity of the Instructional Development Section. Rather, the section staff works with faculty members and other subject-matter experts to provide development input and support for the courses presented by the other sections. In addition, the Instructional Development Section administers and supports preparation of audiovisual materials, including videotapes and audio cassettes. The section does, however, have major responsibility for APTI's orientation course, 422-A Air Pollution Control.

422-A Air Pollution Control

Instructional Development Section

GENERAL COURSE DESCRIPTION

Currently, the course intent is to provide an orientation and overview of air pollution, its effects and its control, with special emphasis on legal and legislative contexts. The course is directed toward agency personnel and is packaged as a set of audiotape/booklet self-instructional modules. The major recommendations reflect the intent of broadening the scope of the course to include the private sector and the general public and increase emphasis on the responsibilities, rights, and activities of industry and the public in air pollution control.

INTENDED AUDIENCE

The course is intended for new employees in air pollution control agencies, and may be useful to employees with up to several years' experience who need exposure to the overall air pollution control effort. It should also be intended as a first exposure to air pollution topics for industrial personnel (e.g. new members of a company air pollution control staff), special interest groups, and the general public. The course should be useable by high school and college students, by itself or as part of a larger course.

COURSE GOALS

Currently, the goals are to provide coverage of important and basic terminology and content in the following topic areas:

1. Air Pollution Law
2. Air Pollutants and Their Sources
3. The Effects of Air Pollution
4. Control Techniques - Gases and Particulates
5. Air Pollution Control Standards and Regulations

6. Enforcement Systems
7. Air Quality Management
8. Meteorology in Air Pollution Control
9. Sampling and Analysis

It is suggested that three additional topic areas be added:

10. Air Pollution Control Through Transportation and Urban Planning
11. Auto Emissions Inspection and Control
12. The Roles of Agencies, Industry, and the Public in Air Pollution Control.

SKILL AND KNOWLEDGE COVERAGE

The skills and knowledge coverage as listed in the 422-A Course Description (see Volume I) appears more than adequate to introduce the original topic areas. Content experts should review material in each topic area to:

1. Eliminate terminology and concepts not central to the introductory level understanding of the topic area by the intended audience.
2. Provide more complete explanation and examples of remaining concepts.
3. Provide more frequent presentation of review questions and problems requiring the trainee to apply what he has learned.

Steps 1 and 2 would have the combined effect of reducing the information density without materially affecting the trainee's basic understanding of the topic area. The resulting material should be more easily learned and remembered.

Representative knowledge coverage of the added topics is given below. Each is assumed to be taught to the exposure level using the autiotape/booklet method of presentation.

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Air Pollution Control Through Transportation and Urban Planning

Knowledge

1. Knowledge of the interrelationship between urbanization, transportation, and air pollution.
2. Knowledge of the enabling legislation related to transportation and urban planning.
3. Knowledge of the roles played by EPA and other federal agencies, state and local air pollution control agencies, highway departments, and planning agencies.
4. Knowledge of the factors considered in planning (e.g., dispersion of pollutants and land use).
5. Knowledge of the process by which transportation and urban plans are developed and implemented, including major difficulties.
6. Knowledge of the use of impact statements in planning, what they contain, and how they are developed.
7. Knowledge of alternate transportation and urban models or systems.

Auto Emissions Inspection and Control

Knowledge

1. Knowledge of types of automotive emissions and their contribution to the total pollution problem.
2. Knowledge of the enabling legislation (e.g., the Clean Air Act), its relevant content, and the roles of federal, state, and local air pollution control agencies in enforcing the legislation.
3. Knowledge of the principles of operation of the internal combustion engine as they relate to the production of emissions.

4. Knowledge of typical systems to reduce emissions (e.g., positive crankcase ventilation, exhaust recirculation, timing and carburation modification).
5. Knowledge of common inspections procedures (e.g., idle test, ACID test, walk-around inspections), their advantages and disadvantages.
6. Possible future developments in power plants, fuels, and auto use restrictions.

Roles of Agencies, Industry, and the Public in Air Pollution Control

Knowledge

1. Knowledge of typical agency objectives and activities (e.g., development of regulations, plan review, inspection, source testing, air monitoring, forecasting air quality).
2. Knowledge of the basic concerns of the industrial or commercial polluter concerning air pollution control. These include necessity, cost, availability of controls, effectiveness of controls once installed, projected life (i.e., how soon the control approach will be made obsolete due to passage of more stringent regulations).
3. Knowledge of the relationship between the polluter and the agency, roles each play, and the responsibilities and rights of each. This includes emphasis on cooperative activities (e.g., agency/industry cooperation to assure both fair and effective regulations).
4. Knowledge of the role of the public in air pollution control: To observe and make informed criticisms concerning the roles of both agency and industry and to make these judgments known in a manner most likely to result in corrective action.
5. Knowledge of common ways the public can act, individually or as organizations, to effect changes (e.g., complaints of violations, letters to agency and industrial personnel and to legislators, citizen suits).

6. Knowledge of sources of information concerning regulations, agency activities, research on pollutants, control techniques and other pollution-related topics.

COURSE FREQUENCY

Course can be taken by one or more trainees (assuming more than one set of booklets is available) at their convenience. To assure maximum availability, the course materials should be supplied to all regional training centers and major control agencies. Arrangements should be made with these facilities to provide the course to industry and the public on a lend/lease basis. The course should also be available on the same basis from APTI. The availability of the course should be noted in APTI and agency publications to industry and the public.

COURSE LENGTH

Recorded material can probably be reduced five to ten percent without impairing the effectiveness of the course as an introduction by reassessment of content.

The addition of more frequent review questions could add ten percent to the total time required to audit the course. The additional modules should require 30 to 45 minutes each for the recorded material.

PREREQUISITES

None.

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Introduction to Surveillance and Laboratory Section

The courses administered by the Surveillance and Laboratory Section fall into five areas:

1. Sampling procedures, covered by:
   - 435 Atmospheric Sampling
2. Laboratory analysis procedures, including:
   - 436 Determination and Measurement of Atmospheric Metals
   - 429 Gas Chromatographic Analysis of Air Pollutants
   - 464 Analytical Methods for Air Quality Standards
   - 465 Determination of Polycyclic Aromatic Hydrocarbons
3. Sampling and identification of selected pollutants using microscopy. This area is covered by:
   - 420 Air Pollution Microscopy
   - 405 Sampling and Identification of Pollen and Fungus Spore Aero-Allergens
4. Effects of pollutants, covered by:
   - 448 Effects of Air Pollution on Vegetation
5. Meteorology, including continuous monitoring and modeling, as prescribed in courses:
   - 411 Air Pollution Meteorology
   - 447 Meteorological Instrumentation in Air Pollution
   - 463 Air Quality Monitoring Systems
   - 423 Diffusion of Air Pollution - Theory and Application

Recommendations and suggested modifications for these courses are presented in the order of the above listing. This section concludes with the description of a proposed new course, 1 Maintenance of Laboratory Equipment.

In addition to presenting modifications designed to improve the quality and/or efficiency of training, the recommendations for the laboratory analysis procedures courses consider the evolutionary nature of course content. As new pollutants are identified, new standards are promulgated, and techniques of surveillance and analysis change, the content and emphasis of the analyses procedures courses must change. Analyses courses (such as 465) which cover new techniques tend to emphasize theoretical background; but, as techniques evolve, training emphasis tends to shift to the performance aspects. This occurs because, as more becomes known about the technique, the theory and background needs of the prospective trainee can be satisfied through other channels (e.g., professional journals). Courses (such as 464) covering more matured techniques fill the trainee's needs best by emphasizing high accuracy standards in the performance of analysis procedures. The recommendations for the laboratory analysis procedures courses attempt to facilitate the periodic revisions that should occur as their content evolves from theory emphasis to quality performance emphasis.

Many of the courses in the Surveillance and Laboratory Section specify as prerequisite the basic skills and knowledge of a trained chemical laboratory technician. These skills and knowledge include the following:

1. Knowledge of general chemical nomenclature in the areas of:
    a. The metric system of measurement
    b. Standard analytical laboratory apparatus (e.g., flasks, burettes, absorbers, pumps, etc.)
    c. Standard chemical processes (e.g., filtration, titration, precipitation, etc.)
    d. Commonly used reagents

    e. Commonly measured pollutants

    f. Computations (e.g., standard temperature and pressure, calibration plot, line of best fit, etc.)

2. Ability to clean glassware and other apparatus without breakage or personal injury.

3. Ability to assemble apparatus into a leakproof assembly, using butt-to-butt connections, Tygon tubing, and silicone or fluorocarbon grease.

4. Ability to handle pressurized gas without endangering personnel or equipment.

5. Ability to prepare reagents and handle caustic or otherwise dangerous chemicals without injuring personnel or damaging equipment.

6. Ability to accurately obtain definite volume of solutions using apparatus such as pipette, syringe, volumetric flast, or burette.

7. Ability to transport and handle filtering media so as not to contaminate it or lose material prior to weighing and analysis. Ability to use forceps for this purpose, if required.

8. Ability to read and interpret data from a table, psychometric chart, or nomograph.

9. Ability to prepare a calibration curve and compute the slope of the best-fitting straight line, following a detailed step-by-step procedure.

10. Ability to quickly and correctly solve an algebraic equation in several unknowns, using a detailed step-by-step procedure.

11. Ability to distill deionized and nitrate-free water.

12. Ability to filter precipitate from a sample solution, and wash the filter and apparatus to recover all the filtrate.

13. Ability to titrate solutions and detect subtle color change.

14. Ability to operate a drying oven and desiccator.

15. Ability to use an analytical balance to obtain an accurate weight. This includes the ability to:

    a. Zero the balance

    b. Adjust sensitivity range without extreme changes that might damage the balance

    c. Read and interpret the indicated mass.

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435 Atmospheric Sampling

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

Course 435 is proposed as a modularized course that can flexibly provide training for a widely varying student population. Training would be organized into individual modules presenting the aspects of one topic, typically, a single instrument or a closely related group of instruments. Modules would be composed of instructional units, each presenting a single topic (e.g., principles of operation, description of the equipment, calibration procedure) within the module. Instructional units would be structured using such elements as readings, self-directed procedures, films, taped presentations, problem assignments, and/or videotapes. The trainee would select the modules he requires, based on activities within his job assignment. For further flexibility, a trainee could, with the guidance of his instructor, select units within the module which best suit his needs.

Instructional staff would relate to each individual trainee to advise, schedule, and critique, as needed.

INTENDED AUDIENCE

Personnel responsible for supervising sampling activities, and technicians performing sampling activities under supervision.

COURSE GOALS

Currently, course goals are to provide:

1. Knowledge of the selection and application of sampling instruments and methods.
2. Knowledge of the factors affecting sample collection efficiency.

3. Ability to calibrate and operate air sampling devices.
4. Knowledge of current reference methods.

These goals are adequate.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative listing of modules and their skill and knowledge content, based on analysis of the existing course and of the public- and private-sector task analyses. The final listing should be made by subject-matter experts, to reflect the state-of-the-art and to ensure completeness. Three basic types of modules are recommended: introductory, general sampling, and instrument/technique related.

Introductory Module

One introductory module is recommended, covering, basically, content relating to goals 1 and 4. The skill and knowledge content is described below:

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the components of sampling systems	Familiarity	Lecture/Readings/ Demonstration
Ability to select sampling equipment. Includes, for example, knowledge of:	Tutored Practice	Lecture/Readings/ Demonstration/Films

1. Principle and operating characteristics of high-volume samplers, plus: size of particles collected; need for equipment; maintenance; types of analysis; limitations; and modification for specific particle size.
2. Principles of adsorption.
3. Principle and operating characteristics of the respirable dust sampler.
4. Methods of collecting and analyzing oxidants, oxides of nitrogen, oxides of sulfur, hydrocarbons, oxides of carbon, and particulates; and the:
   Absorbing materials used
   Advantages/disadvantages of the sampling methods used
   Interferences
   Detector limits
   Sampling rates
   Air volume
   Length of sampling period
   Collection efficiency
5. Types of adsorption
6. Variables affecting gas adsorption capacity

7. Makeup of ideal adsorbent
8. Advantages/disadvantages of adsorption
9. Typical adsorbents and their use
10. Use of detector tubes
11. Reasons to use grab sampling
12. Types of available grab-sampling equipment
13. Advantages/disadvantages of grab sampling
14. Theory of freeze-out sampling
15. Typical freeze-out series
16. Uses for freeze-out sampling
17. Advantages/disadvantages of freeze-out sampling
18. Mechanism employed, collection efficiencies, and factors affecting collection efficiencies of:
    Inertial Samplers
    Impactors
    Impingers
    Centrifugal Separators
    Thermal Precipitators
    Electrostatic Precipitators

Knowledge of the limitations associated with available samplers	Familiarity	Lecture/Film/ Readings

General Sampling Module

One module is recommended covering goal 2 and the application aspects of goal 1. The skill and knowledge content would be as described below:

Skills and Knowledge	Teaching Level	Method/Media
Sufficient knowledge of relevant facts to permit development and periodic revision of a sampling schedule giving the times, durations, and locations of sampling	Application	Lecture/Readings/ Film/Demonstration/Exercises
Ability to choose sampling-time lengths and flow rate, in accordance with requirements for sample reliability and representativeness, and to avoid overloading the capacity of various reagents, filters, traps, etc., in the equipment	Tutored Practice	Lecture/Demonstrations/Exercises/ Readings
Sufficient knowledge of the relevant factors to permit establishment and periodic revision of the sample flow rate that must be maintained in various sampling procedures	Familiarity	Lecture/Demonstrations

Instrument/Technique Related Modules

The remaining modules in the course each covers an individual type of sampling apparatus or a sampling technique. The listing of modules is given below, preceded by a representative listing of basic skills and knowledge to be included in each. The Teaching Level for all modules is Coached Practice. Method/Media for each module should provide for a large degree of trainee self-directed activities. Training can best be provided by scheduling independent units for completion by the trainee. The untis within modules might be made up of, or consist solely of assigned readings, filmed material, videotapes, self-directed laboratory procedures, and appropriate exercises. The units would be unified and supported by instructor briefings and self- or instructor-administered evaluations.

Skills and Knowledge

1. Knowledge of the name and location of the various component parts of the instrument/identify the various pieces of equipment required.
2. Knowledge of the function and location of each operation and adjustment control on the instrument.
3. Knowledge of the operating parameters for the instrument.
4. Ability to calibrate the instrument.
5. Ability to operate the instrument/ability to perform the sampling procedure.
6. Knowledge and skills as required for special applications specific to an instrument. For example:
    a. Ability to prepare a standard gas mixture, and analyze it using the Saltzmann method
    b. Ability to determine relative humidity
    c. Ability to make accurate air-flow measurements
    d. Knowledge of air movers
    e. Ability to calibrate and use meters
    f. Knowledge of filter installation and removal
    g. Ability to remove and handle samples

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7. Knowledge of problems and inaccuracies associated with the use of the instrument/technique and how they can be overcome.

Modules

1. Preparation, calibration, and use of a gas-sampling train
2. Operation of the sequential sampler
3. Operation of the high-volume sampler
4. Operation of the A.I.S.I. automatic sampler
5. Operation of the tape sampler
6. Grab-sampling
7. Freeze-out sampling

COURSE FREQUENCY

Schedule by individual trainee's module needs, and within the limitations of instructor and facility availability.

COURSE LENGTH

Individual modules vary from one-half day to two days in length, depending on student rate of progress and whether he requires all the units wihin the module. Length of training will depend upon the number of modules a given student selects.

PREREQUISITES

Prerequisite for the course should be the skills and knowledge associated with a trained chemical laboratory technician (these skills and knowledge are defined in the introduction to this section, see page 41).

436 Determination and Measurement of Atmospheric Metals

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

This course is seen as being in the second stage of the evolutionary process described in the introduction to this section. To a large degree, the course ia already modularized for presentation. This modularization should be emphasized and used as the focal point for development of free-standing, largely self-administered training modules composed of well-defined units. Within each module, a variety of units can be developed presenting different areas of content and/or providing for presentations of the same basic content with varying focus and emphasis. Thus, some students may require units providing theoretical background or sources of theoretical background, while other students may need briefing units explaining the techniques without introducing or requiring in-depth theoretical background. Self-administered laboratory units with descending orders of learning cues, and providing ascending orders of performance complexity, can be used for skill development.

Free-standing modules with interchangeable units can be scheduled flexibly and can be easily revised individually or as interrelated groups within or across modules. Assuming the course evolves in a manner similar to course 464 (i.e., increasing emphasis on more accuracy in the performance of procedures), the modules can be systematically and inexpensively revised to reflect the change in emphasis.

INTENDED AUDIENCE

Chemists and chemical laboratory technicians who supervise and perform analysis procedures.

COURSE GOALS

To provide:

1. Knowledge of EPA-accepted ssmpling and analysis procedures for detection and measurement of metals in ambient air.
2. Ability to perform analysis procedures, including calculations and reports of results.

SKILL AND KNOWLEDGE COVERAGE

The suggested modules are preceded by a listing of representative skills and knowledge that are relevant to all modules. This list is based on analysis of the existing course and of the public- and private-sector task analyses. The final listing should be made by subject-matter experts to reflect the state-of-the-art and to ensure completeness.

The Teaching Level desirable for all modules is Coached Practice. However, as part of development it may be found that some units require a different teaching level. Method/Media within modules must be determined by the nature of the module goals and content. A large measure of trainee activity should be self-directed, with instructors providing support, individual help, and coordination of activities.

Skills and Knowledge

1. Knowledge of proper sampling and separation techniques for analysis for metal content.
2. Ability to handle samples and prepare for analysis.
3. Knowledge of choices involved in analysis technique for various metals.
4. Ability to operate the equipment involved (using preceding instrument-specific modules as needed, for prerequisites).
5. Knowledge of required reagents, procedures for their preparation, cautions attending preparation and use, method of storage, and shelf life.

6. Knowledge of apparatus and materials for the task, and ability to locate and assemble them.
7. Knowledge of and ability to carry out the task procedure with all steps in proper sequence.
8. Knowledge of and ability to carry out the procedure for calculating the pollutant concentration, including the correction to standard temperature and pressure, as required.
9. Ability to prepare a test atmosphere, containing known concentrations of the gaseous pollutants of concern.
10. Ability to perform special skills specific to an analysis, such as purging and sealing a Goetz tube or Erlenmeyer flask with nitrogen gas; preventing the formation of emulsion in a sample by means of proper agitation; operating the refluxing apparatus; or estimating the purity of pararosaniline hydrochloride.

Modules

1. Analysis techniques for nickel
2. Analysis techniques for arsenic
3. Analysis techniques for beryllium
4. Analysis techniques for manganese and cadmium
5. Analysis techniques for mercury
6. Analysis techniques for antimony
7. Analysis techniques for copper and tin
8. Analysis techniques for selenium
9. Analysis techniques for lead

Alternatively, modules may be built partly around analysis for a specific metal (as listed above) or around specific techniques (such as atomic absorption or fluorescence).

COURSE FREQUENCY

Continue scheduling at intervals throughout the year, evolving to scheduling of modules as needed by individual trainees.

COURSE LENGTH

Retain ten-day length, evolving to flexible length by needs of individual trainees.

PREREQUISITES

Although not mandatory, it is suggested that trainees be advised to complete course 435 Atmospheric Sampling prior to taking course 436. Taking the courses in this order would ensure that trainees come to course 436 with a knowledge of sampling techniques.

Require basic skills and knowledge associated with a trained chemical laboratory technician (see the list in the introduction to this section, page 41).

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429 Gas Chromatographic Analysis of Air Pollutants

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

Proposed is a two-level, modularized course which can provide training for more than one type of trainee. By defining modules based on content areas and course goals, the total course can be more flexibly scheduled. As the course evolves beyond the stage of presenting gas chromatography as a new procedure, theoretical and historical background may cease to be an appropriate area for presentation by APTI. The typical revisions of an evolving course such as this one can be more easily accomplished using the suggested two-level, modularized approach. Providing well-defined, interchangeable units within modules can provide for further flexibility in efficiently meeting individual student needs.

Level 1 is intended to provide in-depth training in (a) theoretical and historical background of gas chromatography, (b) selection of this technique in comparison to others, (c) advantages and disadvantages of the technique, and (d) procedural difficulties associated with successful use of gas chromatography.

Level 2 is intended to provide skill development training in performing analyses using gas chromatography. Trainees who do not need Level 1 would complete briefing units providing the background needed for effective skill development. Trainees who had completed Level 1 would proceed directly to on-hands procedural practice units.

If instructor staff is available, both levels could be ongoing concurrently for the two major audiences. In this way, Level 1 trainees could observe ongoing procedures being done by Level 2 trainees. By scheduling Level 2 concurrently with Level 1 and also for the two days immediately following Level 1, trainees requiring both levels could complete training in a single week (in a manner similar to the current training scheduling). Trainees needing only Level 2 could complete their training early in the week and return to their jobs, or continue on to training in other techniques (e.g., course 467 modules).

Modules in both levels should be free-standing and should utilize self-instructional, self-directed units wherever possible.

INTENDED AUDIENCE

Level 1

Chemists responsible for evaluating and selecting procedures.

Level 2

Chemists and chemical laboratory technicians responsible for supervising and performing analyses using gas chromatography.

COURSE GOALS

Level 1

To provide:

1. Knowledge of the theoretical and historical background of gas chromatography.
2. Knowledge of the principles underlying the technique as an analytical procedure.
3. Knowledge of the equipment, personnel, and supplies needed for performing the technique.
4. Knowledge of the factors surrounding the choice of gas chromatography as an analytical tool as compared to other possible techniques.

Level 2

To provide:

1. Knowledge of the equipment, personnel, and supplies needed for performing the technique.
2. Ability to perform gas chromatography procedures to analyze ambient air for organic pollutants.

SKILL AND KNOWLEDGE COVERAGE

A representative listing of skills and knowledge is provided for each level. The list is not intended to be exhaustive. Final listing should be done by subject-matter experts to reflect the state-of-the-art and to ensure completeness. Because the course is still developmental, modules have not been suggested. Definition of modules, determination of teaching levels, and specification of teaching method and media must be made as part of course development. It is suggested that Teaching Level be at least Familiarity for knowledge items and Coached Practice for skills. Method/Media should be largely self-instructional, with as much material designed for trainees' self-direction toward the defined goals as possible.

Level 1

Knowledge

1. Knowledge of the factors surrounding selection of gas chromatography as a technique for analysis of ambient air for organic pollutants.
2. Knowledge of the theoretical principles of the technique.
3. Knowledge of the developmental history of the technique.
4. Knowledge of the procedure for performing a gas chromatographic analysis.
5. Knowledge of the equipment, personnel, and supplies needed to perform the procedure.
6. Knowledge of the procedural difficulties associated with the technique.
7. Knowledge of information sources pertinent to the technique.
8. Knowledge of critical steps in the procedure, hazards associated with the procedure, possible errors that occur during analysis, and the limitations of the procedure.
9. Knowledge of ancillary techniques for analysis of ambient air for organic pollutants and their comparison to the technique of gas chromatography.

Level 2

Skills and Knowledge

1. Knowledge of the equipment, personnel, and supplies needed to perform the gas chromatography analysis procedure.
2. Knowledge of the operational parameters of the equipment.
3. Ability to perform a gas chromatographic analysis for organic pollutants. This includes the following abilities:
    a. Ability to operate the Perkin-Eliner 900
    b. Ability to perform procedures to:
        (1) Do temperature programming at a gas chromatographic column
        (2) Prepare a controlled atmospheric pollutant concentration
        (3) Analyze a sample for C_1 - C_5 hydrocarbons
        (4) Determine theoretical plate height (HETP)
        (5) Inject samples and interpret peak height and area
        (6) Determine components of a sample of unknown mixture by comparing retention time to a known standard
        (7) Analyze a sample for aromatic hydrocarbons
        (8) Prepare calibration curves

COURSE FREQUENCY

Schedule periodically throughout the year with Level 1 and Level 2 offered concurrently (assumes instructor availability) early in the training week, and repeat Level 2 at the end of the same training week.

Also offer Level 2 upon request or as a series of modules available at the same time as training in other analysis procedures.

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COURSE LENGTH

Level 1

Two days

Level 2

Three days (Some trainees may complete training in slightly more or less time depending on individual pace and total units taken.)

PREREQUISITES

Level 1

Require a minimum of a B.S. in chemistry, including at least one course in organic chemistry.

Level 2

Require basic skills and knowledge associated with a trained chemical laboratory technician (see the list in the introduction to this section, page 41).

464 Analytical Methods for Air Quality Standards

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

The course is currently evolving from its existing form to a modularized form that offers individual pollutant analysis training. The modularized form will be renumbered as 467, with modules designated as A, B, etc. The first three modules are nearing completion in their development, and a fourth is under consideration. These modules will be offered separately, at least until their final format, content, and criteria are determined.

It is recommended that the developmental process suggested in the General Recommendations section of this report be utilized to prepare the new 467 modules. As 467 develops, these modules can replace 464 and serve as a model for the development of other laboratory analysis modules.

INTENDED AUDIENCE

Chemists and chemical laboratory technicians who supervise and perform analysis procedures.

COURSE GOALS

To provide:

1. Ability to perform reference method analysis procedures, including relevant calculations and report of results, with a high degree of proficiency and to a superior level of performance quality.
2. Ability to operate laboratory and continuous monitoring instrumentation.

SKILL AND KNOWLEDGE COVERAGE

Following the present content of course 464 and the public- and private-sector task analyses, two types of modules can be defined: laboratory analysis modules and operation of laboratory and continuous monitoring instrumentation modules. An illustrative list of modules of each type is provided below, preceded in each case by a list of the skills and knowledge that could be included in that type of module. These are representative skill and knowledge lists. Final lists should be compiled by content experts during the development of the modules.

The Teaching Level for all modules is Developmental Practice. The Method/Media must be determined by examination of module goals and content. A large measure of trainee-directed activities should be developed with scheduling of units being based on the individual trainee's needs. Units might be made up of, or consist solely of, assigned readings, filmed material, videotapes, self-directed laboratory procedures, and appropriate exercises. The units would be supported and unified by the instructional staff.

Laboratory Analysis Modules

Skills and Knowledge

1. Knowledge of alternative procedures for analyzing the pollutant and the advantages and disadvantages of each.
2. Ability to operate the equipment involved (using instrument-specific modules as needed, for prerequisites).
3. Knowledge of required reagents, procedures for their preparation, cautions attending preparation and use, method of storage, and shelf life.
4. Knowledge of apparatus and materials for the task, and ability to locate and assemble them.
5. Knowledge of and ability to carry out the task procedure with all steps in proper sequence and produce a result within the required limits of error.

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6. Knowledge of and ability to carry out the procedure for calculating the pollutant concentration, including the correction to standard temperature and pressure, as required.
7. Ability to prepare a test atmosphere, containing known concentrations of the gaseous pollutants of concern.
8. Ability to perform special skills specific to an analysis, such as purging and sealing a Goetz tube or Erlenmeyer flask with nitrogen gas; preventing the formation of emulsion in a sample by means of proper agitation; operating the refluxing apparatus; or estimating the purity of pararosaniline hydrochloride.

Modules

1. Procedures for determining SO_2 concentrations
2. Procedures for determining NO_2 concentrations
3. Procedures for determining oxidant concentrations
4. Procedures for determining particulate concentrations
5. Procedures for determining CO concentrations
6. Procedures for determining hydrocarbon concentrations

Operation and Maintenance of Laboratory and Continuous Monitoring Instrumentation Modules*

Skills and Knowledge

1. Knowledge of procedures for and ability to start up and operate the instrument.
2. Knowledge of procedures for and ability to calibrate or otherwise adjust the instrument.
3. Knowledge of the function and location of each operating and adjustment control on the instrument.
4. Knowledge of the name and location of various component parts of the instrument.

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*Many of these modules may be considered prerequisite to the laboratory analysis module which utilizes the instrumentation.

Modules

1. The spectrophotometer and colorimeter
2. The atomic-absorption spectrophotometer
3. The fluorescent spectrophotometer
4. The flame-ionization hydrocarbon analyzer
5. The NDIR analyzer
6. The coulometric SO_2 analyzer
7. The gas chromatograph analyzer
8. The NO, NO_2, and NO_X chemiluminescent analyzer
9. The flame-photometric total-sulfur analyzer
10. The chemiluminescent ozone analyzers

COURSE FREQUENCY

Continue with plans to schedule modules separately as developed and unify scheduling (i.e., present modules together) as 467 evolves. A suggested scheduling pattern for the modules listed would be to schedule two to three modules concurrently with remaining modules scheduled in subsequent weeks until all had been presented. In this manner, students could take several or all of the modules in one trip. The unified, modular course should be scheduled several times annually.

COURSE LENGTH

Individual modules will require two to two and one-half days depending upon the complexity of the procedures, the student pace, and the units desired or needed by individual trainees.

PREREQUISITES

Although not mandatory, it is suggested that trainees be advised to complete course 435 Atmospheric Sampling prior to taking 464. Taking the courses in this order would ensure that trainees come to 464 with a knowledge of sampling techniques.

Require basic skills and knowledge associated with a trained chemical laboratory technician (see the list in the introduction to this section, page 41).

465 Determination of Polycyclic Aromatic Hydrocarbons

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

Course 465, because it is concerned with an area which is still undergoing relatively active development, can be considered to be in an early evolutionary stage. Because it is still developmental, 465 offers an opportunity to proceed with development along the lines suggested in the General Recommendations section of this report. Course development must emphasize well-defined modules and instructional units which can be individually modified, as required, as the course evolves.

Consideration should be given to combining this course with 429, particularly for purposes of providing the historical and theoretical backgrounds of gas chromatography. If, as suggested in the introduction to this section, the trainee's needs evolve away from theoretical content toward development of skills in the performance of analysis techniques, the need will arise for modules similar to those planned for 467. Present developmental planning should take into account the possibility of such a shift in emphasis, and present course modules and units should be planned so that they can be easily deleted, revised, and reorganized to meet the changing need.

The two-level approach suggested in a number of courses (e.g., 429) might be a useful framework for structuring the present content of 465.

INTENDED AUDIENCE

Retain the currently intended audience definition, which is chemist.

COURSE GOALS

Retain the current course goals:

1. Knowledge of the nomenclature, equipment, and basic procedures involved in the extraction and analysis of an air sample for polycyclic aromatic hydrocarbons.

2. Ability to follow the provided analysis procedure, to recognize and self-correct mistakes in technique.
3. Identify widespread nature of sources and develop a concern for the need to analyze for the compounds.

SKILL AND KNOWLEDGE COVERAGE

Retain skills and knowledge as listed in the Course Description for 465 found in Volume I. Method/Media should evolve to more student-directed and -paced materials which free the instructor to provide specialized help.

COURSE FREQUENCY

Schedule as currently, several times per year, until course modules can be offered on request.

COURSE LENGTH

Retain at three days.

PREREQUISITES

Require a minimum of a B.S. in chemistry, including at least one course in organic chemistry.

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420 Air Pollution Microscopy

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

Little change has been recommended for this course. However, the description here constitutes a more complete listing of existing course characteristics, based on updated course information obtained during the evaluation of the courses.

The course provides training in the use of a microscope to identify particulate pollutants. Laboratory sessions, at least two of which have been developed as self-instructional, provide practice in microscope use and in particle handling for identification.

INTENDED AUDIENCE

Chemists and chemical laboratory technicians involved in identifying or supervising the identification of airborne particles.

COURSE GOALS

1. Ability to operate a microscope.
2. Ability to classify particulates.
3. Ability to identify particulates by morphological characteristics.
4. Exposure to the various particulate sampling methods, and their advantages/disadvantages for microscopic examination.
5. Familiarity with what constitutes a good microscope.
6. Familiarity with photo-micrography.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list based on analysis of the existing course and of the public- and private-sector task analyses.

The final listing should be made by subject-matter experts to reflect the state-of-the-art and to ensure completeness.

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the components of microscopes, the standards of quality associated with them, and their principles of operation	Familiarity	Illustrated Lecture/ Demonstration/Assigned Reading
Knowledge of the principles of polarized light and how these principles are used to adequately illuminate particulates being examined	Familiarity	Illustrated Lecture/ Demonstration/Assigned Reading
Knowledge of sampling methods, and their effects on the samples which are collected for identification of particles	Exposure	Illustrated Lecture (live or taped)
Knowledge of the six crystal systems and their use in particle identification	Application	Illustrated Lecture/ Demonstration/Student Exercises
Knowledge of when to use dispersion staining and when to use refractive index techniques, for particle identification	Application	Illustrated Lecture/ Demonstration/Student Exercises
Ability to use a microscope, including: calibration obtaining an image proper illumination	Coached Practice	Laboratory Sessions
Ability to identify small particles by chemical name, using dispersion-staining techniques	Coached Practice	Laboratory Sessions
Ability to use refractive indexing to identify particulate matter	Coached Practice	Laboratory Sessions
Ability to do photo-	Tutored Practice	Laboratory Sessions

COURSE FREQUENCY

Schedule periodically throughout the year.

COURSE LENGTH

Five days

PREREQUISITES

None

405 Sampling and Identification of Pollen and Fungus Spore Aero-Allergens

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

There are no modifications suggested for this course. The current structure and methodology includes laboratory and field work, lecture, demonstration, and illustrative materials. It is estimated that at the completion of the 5-day course, 80% of the students will be able to identify 60% of the aero-allergens present on the instructor-prepared unknown samples. The course is presented upon request. See the current course description for a more detailed discussion.

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448 Effects of Air Pollution on Vegetation

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

The course as described here has no recommended modifications. However, a more complete listing of goals is provided, based on updated course information obtained during course evaluation.

The course intent is: (1) to provide information on visual symptoms of plant damage due to air pollution, and (2) to teach discrimination between plant damage from air pollution and from other causes. Another intent is to keep information lines open and promote cooperation between Agricultural Extension personnel and Control Agency personnel, in identifying vegetation damaged by air pollution.

The course technique is primarily lecture, illustrated by slides and transparencies. It is conducted by university faculty under contract to APTI. A field trip may be made to show students actual examples of damaged plants, if a usable example is near the course presentation site. Plans are tentative for greenhouse research facilities associated with Research Triangle and with local universities to provide specimens of damaged vegetation.

INTENDED AUDIENCE

This course is offered for two distinct audiences, and is presented in slightly different ways for each.

Control Agency Course

Agency personnel interested in obtaining a basic knowledge of air pollution effects on vegetation.

Agricultural Extension Course

Agricultural Extension personnel.

COURSE GOALS

Control Agency Course Only

Knowledge of physiological and anatomical characteristics of plants.

Both Versions of Course

1. Knowledge of the role of agricultural and agency personnel (a) in detecting plant damage due to air pollution, and (b) in cooperating to determine the source(s) of pollution.
2. Skill in recognizing plant damage due to air pollution, and discriminating that damage from damage due to other possible causes.
3. Knowledge of ways to assess damage to vegetation.
4. Skill in performing a plant survey.
5. Knowledge of the chemistry and meteorology of air pollution, relevant to vegetation damage.

SKILL AND KNOWLEDGE COVERAGE

No modification in the existing skills and knowledge is suggested. See the Current Course Description for the listing.

COURSE FREQUENCY

Arrange upon request only.

COURSE LENGTH

Five days for either version.

PREREQUISITES

None.

411 Air Pollution Meteorology

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

Proposed is a two-level course that would provide specialized training to two different student populations. Level 1 addresses the skills and knowledge needed for the task of forecasting pollution levels and effects, including predicting inversions and issuing advisories. Level 2 addresses the skills and knowledge needed for the task of assembling meteorological data and describing climatological conditions.

Both levels of the course could be packaged for presentation at regional offices, if provisions can be made for use of audiovisual media such as slide/tape, film, or videotape.

Topics formerly presented by this course (selection, use, and maintenance of meteorological instrumentation associated with air pollution surveillance and monitoring systems) are covered in 463 Air Quality Monitoring Systems and 447 Meteorological Instrumentation.

INTENDED AUDIENCE

Level 1

Meteorologists

Level 2

Meteorological technicians

COURSE GOALS

Level 1

To provide:

1. Knowledge of the dynamics of air pollutants in the atmosphere.

2. Ability to use descriptions of current or recent meteorological conditions, to forecast pollution-related meteorological conditions and associated pollution characteristics.
3. Familiarity with the current research activities in air-pollution meteorology.

Level 2

To provide:

1. Knowledge of the type and format of information needed by the meteorologist for preparing forecasts.
2. Ability to collect meteorological data from instrumentation or other sources (e.g., National Weather Service, private consultants).
3. Ability to organize, analyze, and manipulate the data, using a specified procedure.
4. Ability to use the data to prepare a description of climatological conditions.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list based on analysis of existing courses and the public- and private-sector task analyses. The final listing should be made by subject-matter experts to reflect the-state-of-the-art and to ensure completeness.

Level 1

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the relevant properties of pollutants (e.g., interaction with sunlight) and emission sources (e.g., locations; emission output; emission patterns as a function of time, season, etc.) which interact with meteorological conditions to produce contamination levels	Familiarity	Illustrated Lecture/ Assigned Reading

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Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the procedures for forecasting meteorological conditions relevant to air pollution control	Familiarity	Illustrated Lecture/ Assigned Reading
Knowledge of the guidelines, criteria, rules of thumb, contingency plans, etc., used in subjective systems for predicting pollution levels from meteorological conditions	Exposure	Lecture/Assigned Reading
Ability to interpret stochastic relationships of meteorological levels (e.g., regression equations; measures of central tendency and variance)	Tutored Practice	Introductory Briefing/ Exercises
Ability to use and interpret the interrelationships of meteorological conditions with: 1. Air Stagnation Narratives or Advisories 2. Historical records of local meteorological characteristics and topographical effects which influence pollution levels	Coached Practice	Lecture-Demonstration/ Exercises
Ability to integrate information relevant to contaminant properties, source characteristics, and meteorological conditions, to forecast contaminant levels for up to 24 hours from forecast time	Coached Practice	Lecture-Demonstration/ Exercises
Knowledge of the procedure for using objective (i.e., relatively mechanical) systems for predicting contamination levels from meteorological data	Exposure	Lecture/Resource Reference
Knowledge of the criteria for issuing an advisory	Familiarity	Lecture/Exercise

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of current research activities	Exposure	Assigned Reading

Level 2

Teaching Level for all the knowledge items is Familiarity, and for all skills is Coached Practice. Method/Media should include illustrated lectures, demonstrations, and student exercises.

Skills and Knowledge

1. Ability to read a weather map.
2. Ability to plot an adiabatic diagram.
3. Ability to produce wind and pollution roses.
4. Knowledge of the graphic procedures used to identify, describe, and forecast inversion characteristics (e.g., strength, height, break temperature).
5. Ability to use graphic methods to determine inversion strength, height, and break temperature.
6. Knowledge of the data plot pattern for each of the types of inversions the meteorologist is required to recognize (e.g., frontal and subsidence inversions).
7. Ability to plot and contour meteorological data (e.g., isotherms, isobars).
8. Ability to accurately extrapolate from incomplete temperature records, so as to forecast inversion onset time.
9. Ability to decode teletype transmissions rapidly and accurately (e.g., NWS, military circuit).
10. Knowledge of the types of errors which can occur in meteorological data reported by NWS Radiosonde, the relative likelihood of their occurrence, and methods for estimating the proper data points as a function of meteorological principles and the evolving data patterns.

11. Ability to recognize errors in teletype printout (e.g., unreasonably high or low wind speed), and identify a "ball park" data point which is both probable within the evolving data context, and meteorologically plausible.

12. Ability to plot meteorological data in a format appropriate to the charting medium employed.

    a. Meteorological data includes:

        (1) Temperature

        (2) Dew point

        (3) Wind velocity and direction

        (4) Visibility

        (5) Cloud conditions

        (6) Pressure systems

    b. Typical types of charting media:

        (1) ATA Chart 20 Skew T Diagrams

        (2) ESSA (Dept. of Commerce) Pseudo-Adiabatic Chart

        (3) Area surface map

13. Knowledge of how to find a private professional meteorologist doing consultant work.

14. Knowledge of the function of meteorologists assigned to NCAPC (National Center for Air Pollution Control), and how to call on them for assistance.

COURSE FREQUENCY

Schedule periodically throughout the year and upon request, with Level 2 scheduled to immediately follow Level 1.

COURSE LENGTH

Level 1

Two days

Level 2

Three days

PREREQUISITES

Level 1

Require students to be professional meteorologists, having the ability to:

1. Use (identify, discriminate, interpret) appropriate information in formal data sources to forecast meteorological conditions.
2. Use graphic methods to determine inversion strength, height, and break temperatures.
3. Determine current ventilation rates using the appropriate NWS charts.
4. Forecast ventilation for a 24-hour period.

Level 2

Require completion of 422-A Air Pollution Control module titled "Air Pollution Meteorology," or demonstrate ability to meet the objectives listed in that module.

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447 Meteorological Instrumentation in Air Pollution

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

This course is seen as being most effectively presented by use of packaged modules, made up of appropriate media such as illustrated tape, videotape, field visits, specialized lecture, and step-by-step procedures.

Students would work in groups and individually, under the guidance of course instructors. The course intent is to provide technician-level personnel with non-instrument-specific skills and knowledge regarding the operation and maintenance of instrumentation used in surveillance and monitoring systems. The existing course goals have been modified and restated to reflect this intent.

INTENDED AUDIENCE

Meteorological and equipment technicians who set up, calibrate, read, and maintain meteorological instruments important in air pollution control.

COURSE GOALS

To provide:

1. Knowledge of the operational theory for typical instruments.
2. Ability to install, calibrate, maintain, and read typical instruments. This includes the ability to understand and use instrument documentation.

SKILL AND KNOWLEDGE COVERAGE

The following listing is a representative list of basic skills and knowledge. All should be presented to the Coached Practice Teaching Level. Appropriate Method/Media depend upon the nature of the skill or knowledge being taught (but possible Method/Media are suggested under General Course Description).

Ths list of basic skills and knowledge is followed by a representative listing of equipment modules. Both these listings should be finalized by a subject-matter expert to reflect the state-of-the-art and to ensure completeness.

Skills and Knowledge

1. Ability to unpack and install the instrument.
2. Ability to perform routine maintenance and periodic checks on the instrument.
3. Ability to troubleshoot and repair the instrument.
4. Knowledge of the function and location of the various component parts of the instrument.
5. Knowledge of the function and location of each operating and adjustment control on the instrument.
6. Knowledge of the tools and materials required for maintaining the instrument.
7. Ability to perform any necessary calibration of the instrument.
8. Ability to read the instrument.

Modules

1. Surface-wind speed sensors
2. Surface-wind direction sensors
3. Wind-measuring transducers
4. Instrumentation for measuring winds aloft
5. Sensors and recorders

6. Temperature sensors and transducers
7. Temperature lapse-rate measurement
8. Instrumentation for secondary meteorological parameters measurement

COURSE FREQUENCY

Schedule periodically throughout the year, and upon request.

COURSE LENGTH

Three to five days.

PREREQUISITES

None

463 Air Quality Monitoring Systems

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

A course to provide the background needed for designing an air-monitoring facility. The course includes determination of design goals, selection of instrumentation (including considerations of selection impact on data handling), site selection, and facility layout.

Instrumentation as used here refers to typical weather instruments, automatic continuous monitoring analyzers, and samplers. Selection of instrumentation is affected by analytical methods and equipment. Coverage of these aspects is found in 464 Analytical Methods for Air Quality Standards.

The course presentation mode is basically illustrated lecture, enhanced by visits to existing installations; selected reading assignments; and guest lecturers having specialized knowledge.

As described here, the course is modified only slightly from present course plans. Modification is primarily one of scope, in that weather instruments and facility layout have been added to the topics indicated for coverage in the existing courses.

INTENDED AUDIENCE

Professional-level staff members having major responsibility in planning, administration, operation, and maintenance of air-quality monitoring facilities.

COURSE GOALS

1. Ability to establish the goals to be fulfilled by the facility.

2. Ability to select instruments and associated data-handling mathods to be used by the facility.
3. Ability to determine appropriate siting for instrumentation.
4. Ability to produce a layout showing the physical design of the facility.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list based on analysis of existing courses and of the public- and private-sector task analyses. The final listing should be made by subject-matter experts to reflect the state-of-the-art and to ensure completeness.

The Teaching Level for all knowledge items is Familiarity, and for all skills is Coached Practice. Method/Media should be: (1) illustrated lecture (videotaped, live, or filmed), (2) site visits to existing facilities, (3) speakers presenting specialized information (e.g., data-handling system specialists, representatives of equipment manufacturers), (4) demonstrations and graphic representation, and (5) use of resources such as equipment literature, articles, etc.

Skills and Knowledge

1. Knowledge of the types of legal restrictions that may affect a selected facility site
2. Knowledge of commercially available equipment, its sensitivity, reliability, response time, and the validity of obtained measurements.
3. Knowledge of costs involved in procurement and operation of the available instrumentation.
4. Knowledge of the factors in locating available instrumentation.
5. Knowledge of the type of data produced by the available instrumentation, and the implications in terms of available data-handling systems.

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6. Ability to establish and document design goals by:

   a. Identifying and describing the intended use of the facility.

   b. Identifying the type and likely concentration range of pollutants which will be found at the facility site.

   c. Identifying unusual environmental characteristics of the facility site.

   d. Identifying social and political characteristics of the community which may impact the facility design, and compensating the design as required.

   e. Determining if fixed, mobile, or multiple-location monitoring is required.

7. Ability to select instrumentation and data-handling factors by:

   a. Weighing characteristics of the various instruments and ranking them in terms of their applicability for use in the specified facility.

   b. Making trade-offs between desirability of instrumentation and costs.

   c. Specifying support materials needed.

   d. Weighing available and desirable data-handling factors, and determining the trade-offs involved between selection of instrumentation and the data-handling factors.

8. Ability to produce a layout of the facility design by:

   a. Selecting appropriate locations for the chosen instrumentation.

   b. Identifying activity patterns.

   c. Estimating workspace requirements.

   d. Drawing facility outline.

e. Laying out equipment and other use areas, taking into consideration the storage needs, equipment-siting requirements, needs for water, access to air-intake manifold, electrical current, exhaust requirements, etc.

COURSE FREQUENCY

Schedule periodically throughout year, and upon request.

COURSE LENGTH

Five days

PREREQUISITES

Require skills and knowledge provided by these courses:

1. 435 Atmospheric Sampling, for skills and knowledge in selection and operation of sampling equipment.
2. 464 Analytical Methods for Air Quality Standards, for skills and knowledge in analytical methods and analyzers.

423 Diffusion of Air Pollution - Theory and Application

Surveillance and Laboratory Section[*]

GENERAL COURSE DESCRIPTION

This course is intended to provide the training needed for use of mathematical models. The models are used to describe and estimate interrelationships of air conditions at surface points, as a function of source emission characteristics and meteorological conditions. As described, the recommended course focuses more sharply than the existing 423 course upon modeling, the types, their characteristics, and how to use them.

INTENDED AUDIENCE

Meteorologists and engineers with a background in meteorology.

COURSE GOALS

Ability to use mathematical modeling to solve such problems as:

1. Determination of appropriate stack height for a new plant, so that its emissions will produce a minimum effect on ambient air quality.
2. Identification of the source of an odor, and determination of its path.
3. Determination of downwind concentrations due to a particular source.
4. Evaluation of the relative advantages of a "roll-back" type of control program, as compared to a selective source-by-source control effort.
5. Determination of whether implementation of a proposed source-emission standard will result in ambient air quality that is in compliance with a specific standard.

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[*] Course 423 is now administered by the Air Quality Management Section

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list based on analysis of the existing course and of the public- and private-sector task analyses. The final listing should be made by subject-matter experts to reflect the state-of-the-art and to ensure completeness. The Teaching Level for all knowledge items is Familiarity, and for the broadly stated skill, Tutored Practice. Method/Media are somewhat dependent on the availability of computer facilities. However, adequate use can be made of lectures, simulations, exercises, field trips, and selected reading assignments. The following list assumes that more complex calculations are done by computer, and that programming and computer operation are not the responsibility of the audience (meteorologists).

Skills and Knowledge

1. Knowledge of the uses, assumptions, and procedures of mathematical models of pollution diffusion.
2. Knowledge of the inadequacies of a selected mathematical model, so that interpretation of its output can be made as vividly as possible. The following are representative limitations in the frequently used model. The meteorologist should be aware of these limitations in interpreting his findings:
    a. Climatological data used in model calculations should be secured from receptors actually in the area to which the model is to be applied. Too often this data is obtained from airport observing stations located in areas with significantly different climatological conditions than an urban central area.
    b. The model is best suited to simulate the emissions of actual point sources in flat, open terrain for travel distances of no more than a few kilometers.

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Thus, area sources are imperfectly modeled, plume behavior beyond a few kilometers is not adequately simulated by the model, and the model is not well-suited to simulate emission characteristics in regions of varying thermal and surface-roughness conditions.

c. Typically, stability-wind judgments are based upon surface observations. Meteorological data from a sounding has been shown to be the most useful for modeling.

d. The emission data typically found in emission enventories is reported in terms of tons/year. The emission quantities required for use in the model are stated in more refined units (e.g., grams/sec.). Direct transformation from tons/year to grams/sec. assumes a uniform rate of discharge over the entire year. This overlooks seasonal or diurnal variations.

e. The model should not be used to predict concentrations which are anticipated to be, or turn out to be, higher than the values used to calibrate them from initial findings.

f. When considering area sources as "effective point sources," receptor distances must be adjusted to avoid over-estimation of concentrations.

3. Knowledge of the applications, assumptions, and procedures used in making auxiliary data manipulations while using modeling methods, such as:

    a. Development of the required stability-wind rose.

    b. Calculation of "effective stack height."

    c. Variation of averaging period, prediction of annual maxima, and frequency distribution in terms of geometric mean and geometric standard deviation using Larson's techniques.

4. Knowledge of the aids and data available to support modeling problems not requiring computer assistance.
5. Knowledge of the procedures used to evaluate reliability, validity, and appropriateness of input data for use in a specific mathematical modeling procedure.
6. Knowledge of the procedures for calibration of mathematical model output, and of the methods for modifying input data in response to the outcome of the calibration procedure.
7. Knowledge of procedures used to present results which are responsive to original problem and data needs (e.g., plotting derived concentrations on a surface map).
8. Ability to solve selected problems using available mathematical model(s).

COURSE FREQUENCY

Schedule periodically throughout the year, depending on computer-facility availability.

COURSE LENGTH

Five days

PREREQUISITES

Require competence in the skills and knowledge provided by both 801 Environmental Statistics and 426 Statistical Evaluation of Air Pollution Data. Course attendance should be exemptable by means of a pretest (preperably self-administered and self-evaluated).

1 Maintenance of Laboratory Equipment

Surveillance and Laboratory Section

GENERAL COURSE DESCRIPTION

This course is proposed to provide skills and knowledge to personnel filling the role of equipment technician. Included in the term "laboratory equipment" are samplers, analyzers, monitoring equipment, and typical laboratory instrumentation. Meteorological instrumentation is not included since it is covered by 447 Meteorological Instrumentation in Air Pollution. A modularized approach is proposed, with modules covering major equipment items and modules providing training in generalized skills and knowledge. The use of free-standing modules enhances the probability of efficient scheduling and complete, effective training.

Course materials are intended to be largely self-instructional, with a high degree of hands-on practice with the equipment. Careful attention to module development and the use of the self-instructional mode will make it possible to package the course modules for use where equipment items exist in the field.

INTENDED AUDIENCE

Equipment technicians

COURSE GOALS

To provide generalizable skills such as:

1. Reading and interpreting diagrams, charts, and meter scales.
2. Reading and interpreting typical manufacturers' equipment literature.
3. Making standard connections, including tubing, piping, and electrical.
4. Using electrical test equipment.

5. Reading troubleshooting charts.
6. Performing typical troubleshooting and repair operations.
7. Soldering and unsoldering.

To provide specific skills for each item of equipment, such as:

1. Unpacking
2. Inspecting
3. Installing
4. Calibrating
5. Operating
6. Performing routine maintenance
7. Troubleshooting and repair

SKILL AND KNOWLEDGE COVERAGE

The suggested listing of basic skills and knowledge is followed by a list of possible modules. Neither list is intended to be exhaustive. The final listing should be made by subject-matter experts, to reflect the state-of-the-art and to ensure completeness. Maintenance as used in the list of possible modules is intended to include troubleshooting and repair, as well as routine maintenance, equipment setup, and operation.

Skills should be taught to a Coached Practice Teaching Level, using self-instructional Method/Media. Investigation of available materials may uncover already developed training that can be used as a module or as a unit within a module (e.g., soldering). Introduction to skills can be by videotaped demonstrations, or where motion is not essential by tape/slide or filmstrip presentations. Hands-on practice can be provided by step-by-step procedures presented either on audio-tape or in text, and illustrated by flipchart photographs. Final determination of the training method and media to be used for any one module must be made as part of the training development procedure, as presented in the General Recommendations section of this report.

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Skills and Knowledge

1. Knowledge of installation procedures, and ability to install the instrument.
2. Knowledge of procedures for and ability to start up and operate the instrument.
3. Knowledge of procedures for and ability to calibrate or otherwise adjust the instrument.
4. Knowledge of procedures for and ability to service and routinely maintain the instrument.
5. Knowledge of procedures for and ability to troubleshoot and repair the instrument.
6. Knowledge of the function and location of each operating and adjustment control on the instrument.
7. Knowledge of the name and location of various component parts of the instrument.
8. Knowledge of the tools and materials required for maintaining the instrument.
9. Knowledge of the operating parameters of the instrument.
10. Ability to unpack and inspect instruments for dents, breakage, out-of-position components, loose electrical or mechanical connections, and hairline cracks in glass or plastic parts.
11. Ability to detect worn, corroded, dirty, broken, or otherwise defective component parts by visual, tactile, or auditory examination and comparison to properly functioning parts.
12. Ability to coordinate adjustment-screw or hand-knob movements.
13. Ability to detect leaks in hose, tubing, and piping connections carrying liquids, gases, or vacuum (using simple leak-detection aids, as appropriate).
14. Ability to leval an instrument, using a level, plumb, screw adjusters, and/or shims.

15. Ability to read equipment literature to determine:

    a. Installation instructions

    b. Name and location of various component parts of the instrument

    c. Special procedures for unpacking, installing, operating, or maintaining the instrument

    d. Recommended maintenance procedures and schedules

    e. Troubleshooting aids, if any

16. Ability to detect pinched, ruptured, or otherwise defective tubing, and incorrect tubing connections.

17. Ability to connect/disconnect standard hose tubing and piping connectors, achieving leakproof connections and without injury to threads. This includes the use of thread compound and teflon tape, as appropriate.

18. Ability to connect/disconnect standard electrical connectors. This includes identifying wires to facilitate correct connection, and achieving tight connections without damage to the leads or terminals.

19. Ability to correctly interpret function diagrams, wiring and tubing diagrams, simple electrical schematics, and troubleshooting charts.

20. Ability to use electrical test instruments to achieve accurate circuit measurements without damage to the instruments. Such instruments are, e.g.:

    a. AC/DC voltmeter

    b. Ammeter

    c. Ohmmeter

21. Ability to solder and unsolder electrical terminals, making a good electrical and mechanical connection without shorting or grounding the connection, or damaging circuit components.

22. Ability to perform routine maintenance tasks, such as greasing or oiling parts, cleaning parts, inspecting liquid levels, changing filters, etc.

Modules

1. Soldering
2. Basic maintenance and troubleshooting techniques
3. Maintenance of gas-sampling train equipment
4. Maintenance of sequential samplers
5. Maintenance of high-volume samplers
6. Maintenance of the A.I.S.I. automatic sampler
7. Maintenance of the X-ray defractometer
8. Maintenance of the spectrophotometer and colorimeter
9. Maintenance of the atomic-absorption spectrophotometer
10. Maintenance of the [illegible]uorescent spectrophotometer
11. Maintenance of the flame-ionization hydrocarbon analyzer
12. Maintenance of the NDIR analyzer
13. Maintenance of the coulometric SO_2 analyzer
14. Maintenance of the gas chromatograph analyzer
15. Maintenance of the NO, NO_2, and NO_X chemiluminescent analyzer
16. Maintenance of the flame-photometric total-sulfur analyzer
17. Maintenance of the chemiluminescent ozone analyzers

COURSE FREQUENCY

Ultimately should be made available on request.

COURSE LENGTH

Dependent on student pace and the modules taken.

PREREQUISITES

None

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Introduction to Engineering and and Enforcement Section

Courses presented by this section provide training in (1) evaluation of permit applications, (2) engineering and field inspections, (3) general control technology, (4) smoke reading, (5) source sampling, and (6) handling air pollution data. Recommendations and suggested course modifications are provided for this section's courses in the order listed below:

801 Environmental Statistics

426 Statistical Evaluation of Air Pollution Data

444 Air Pollution Field Enforcement

439 Evaluation of Visible Emissions

431 Air Pollution Control Technology

413 Control of Particulate Emissions

415 Control of Gaseous Emissions

427 Combustion Evaluation

450 Source Sampling

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801 Environmental Statistics

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

This course was originally produced by the Office of Water Programs. It was intended to build on a basic statistical knowledge (provided by a 40-hour programmed text) to permit application of statistics to environmental studies.

The course as described here is a packaged course, utilizing videotapes (or other packaged lecture) and student exercises. The course intent is to provide all skills and knowledge needed to perform tests of significance using environmental data. The course is a prerequisite for 426 Statistical Evaluation of Air Pollution Data, which provides further practice in the use of tests of significance.

INTENDED AUDIENCE

Personnel responsible for collecting, analyzing, and interpreting environmental data.

COURSE GOALS

1. Ability to perform basic statistical operations.
2. Ability to perform tests of significance using environmental data.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list based on analysis of the existing course and of the public- and private-sector task analysis. The final list should be prepared by subject-matter experts to ensure completeness and adequate environmental focus.

The Teaching Level for the knowledge items should be Familiarity, and for skills, Tutored Practice. Method/Media should include

Lecture/Demonstration for introduction of concepts and procedures, and Guide Problem Exercises for skill development.

Skills and Knowledge

1. Knowledge of basic statistical concepts and their use (e.g., frequency distribution; measures of central tendency and variability; probability; correlation; regression equations).
2. Knowledge of the concepts of continuous distribution, tests of significance, and binomial populations.
3. Knowledge of statistical outliers.
4. Ability to obtain critical values from tables.
5. Ability to compute and interpret point and interval estimates.
6. Ability to select, compute, and interpret tests of significance.
7. Ability to use bivariate data for analysis, using regression and correlation.
8. Ability to analyze categorical data and compare binomial population.

COURSE FREQUENCY

Have package available for use upon request.

COURSE LENGTH

Package should be modularized and should contain some student-controlled, self-instructional exercises. Course length could then vary according to the modules used, student pace, and scheduling of the course by availability of moderator time. Typically, the course should require about five days.

PREREQUISITES

None

426 Statistical Evaluation of Air Pollution Data

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

The course provides skill in preparing data from automatic continuous monitoring systems for input to available computer-processing systems. Illustrated lectures present characteristics of computer systems and their data-format requirements. Procedures for and practice in preparing the data are provided by illustrated procedures and student exercises. Included as part of the preparation procedures is practice doing tests of significance, a skill learned in 801 Environmental Statistics or through some other statistics course. Course 426 is currently undergoing revision.

INTENDED AUDIENCE

Professional-level personnel responsible for reducing, formatting, and otherwise preparing data for automatic analysis.

COURSE GOALS

1. Knowledge of available data-handling systems and how each impacts on monitoring systems.
2. Knowledge of available computer systems and of data-preparation needs for selected systems.
3. Ability to collect, analyze, collate, reduce, and otherwise prepare data for input to selected computer systems.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list, based on analysis of the existing courses and of the public- and private-sector task analyses. The

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final list should be prepared by subject-matter experts to reflect the state-of-the-art and to ensure completeness.

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of components of data-handling systems, and how they apply to air-quality systems	Familiarity	Lecture/Demonstration/ Reference Materials
Knowledge of how computers are used to process data, including ways to input data, ways to output data, and storage systems	Exposure	Lecture/Reference Materials
Knowledge of NADIS (National Aerometric Data Information Service)	Exposure	Lecture/Reference Materials
Knowledge of NADB (National Aerometric Data Bank)	Familiarity	Lecture/Demonstration/ Reference Material
Knowledge of AQDHS (Air Quality Data Handling System)	Familiarity	Lecture/Demonstration/ Reference Material
Knowledge of AQISB (Air Quality Information Service Bank)	Exposure	Lecture/Reference Materials
Ability to prepare actual data for precessing by one or more selected systems	Coached Practice	Monitored Exercises
Ability to utilize data-filing systems and other information sources	Coached Practice	Monitored Exercises

COURSE FREQUENCY

Schedule periodically throughout the year, and where feasible, in accordance with access to data-system files.

COURSE LENGTH

Five days

PREREQUISITES

Require competence in the skills and knowledge specified in 801 Environmental Statistics.

444 Air Pollution Field Enforcement

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

Currently the intent of the course is to provide the patrol and/or engineering inspector with the background needed to investigate a complaint or make an inspection and to obtain legal evidence of pollution emission violation. This intent appears adequate. This course is currently being packaged for use by non-content-expert instructors in a form minimizing the use of the lecture method and emphasizing self-instruction. This approach seems appropriate and, therefore, recommendations will deemphasize specification of media except for the recommendation that student exercises be structured to simulate actual inspection situations (e.g., conducting a complaint interview). Since some of the material (e.g., conducting a complaint investigation) will be of more interest to routine than to engineering inspectors, such content should be modularized to permit the trainee to select topics of concern to him.

INTENDED AUDIENCE

The course is presently aimed at non-college graduates who are employees of air pollution control agencies. It is recommended that minimum entry level be assumed to be high school graduate with a basic knowledge of agency activities. Previous training in control devices should be assumed (see Prerequisites).

COURSE GOALS

Current course goals are to provide:

1. Ability to handle a complaint in a businesslike and legally acceptable manner.

2. Knowledge of what is expected of an expert witness in court.
3. Ability to be an expert witness in court.
4. Knowledge of typical complaint types (e.g., odor, visible emissions).
5. Knowledge of enforcement procedures and planning.

It is recommended that goals 2 and 3 be eliminated. These will be covered in a new course, 3 Presentation of Expert Testimony.

Add the following goal:

Ability to develop routine and special purpose inspection procedures.

SKILL AND KNOWLEDGE COVERAGE

The skill and knowledge content as described in the Course Description (see Volume I) appear adequate, except that the following should be eliminated:

Knowledge of guidelines for conduct of an expert witness in court.

Knowledge of guidelines for legal and technical staff regarding cooperation for preparing and presenting a case in court.

In addition, at least the following should be upgraded to the familiarity level by provision of student exercises requiring application of principles learned:

Knowledge of limitations and applications of common law in air pollution control.

Statutory law in air pollution control (limitations and applications should be included, also).

Purpose, structure, power, and procedure of a board of appeals.

Elements of trial or administrative hearing procedures in air pollution cases.

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The following New Skills and Knowledge should be added:

Skills and Knowledge	Teaching Level	Method/Media
Ability to correctly apply rules for data gathering to simulated typical inspection situations	Developmental Practice	Group or Individual Exercises
Knowledge of technique for developing an inspection procedure for new and/or non-routine applications; includes analysing the application, identifying inspection points, determining inspection parameters and their acceptable ranges, assuring that typical operating conditions are being observed, devising inspection procedures, developing forms for data collection.	Familiarity	Programmed Instruction/Problems
Ability to conduct a complaint investigation. This involves the following skills and knowledges:	Coached Practice	Programmed Instruction/Readings/Group Problems involving simulation

Ability to conduct a complaint investigation interview with the complainant and secure the required data without falling prey to either personal or the complainant's biases. This includes the ability to recognize exaggerations and contradictory statements from the complainant. This skill also involves the ability to reassure the complainant that the complaint is being adequately handled.

Knowledge of the types of conditions which can produce an unjustified complaint (i.e., no violation of air pollution control regulations involved). These conditions include:

1. Personal antagonism between complainant and alleged violator.
2. Real source of complaint is not related to air contaminant (e.g., noise).
3. Source of complaint is natural rather than man-made (e.g., bee spots, pollen).
4. Sickness or allergy has made complainant unusually hypersensitive to small quantities of contaminants.

General knowledge of the basic psychophysical and perceptual principles related to the human sense of smell. This knowledge can include:

1. Sensory adaptation effects.
2. Adaptation level effects.

   Individual differences in awareness and emotional response to odors.

   The concept of a sensory threshold as a statistical phenomenon which is affected by many external and internal variables (e.g., humidity and past experience).

Knowledge of accepted procedures for detecting or characterizing odors such that illegal concentrations can be identified and related to the responsible source.

Knowledge of the methods for tracking odors in order to identify the likely source of the emission, including:

1. Analysis of wind patterns
2. Area Surveys
3. Use of field test equipment (e.g., Scentometer)

Knowledge of the types and appearance of property damage due to air contaminants. Such damages include:

1. Acid stains
2. Discoloration of paint
3. Dust or fly ash deposits
4. Paint deposits
5. Vegetation damage

Knowledge of the public relations considerations involved in complaint handling. These considerations include:

1. Competent complaint handling can have a great effect on public acceptance and support of agency programs.
2. Voluntary support from the public is critical for enforcement operations (e.g., during episodes). Effective complaint handling will help generate this type of support.

Knowledge of the recommended methods for soliciting cooperation from complainants during a complaint investigation.

Knowledge of the procedures and techniques used for tracking stains and deposits to aid in identifying the probable source. This knowledge includes:

1. Use of aerosol samplers or absorbent type panel paper to secure a sample of the material.
2. How to arrange absorbent type panel paper in a path downwind from the contaminated area to the suspected source.
3. How to interpret the pattern of stains on absorbent type panel paper arranged downwind from the source.
4. What situational data to record at the time samples are secured (e.g., wind speed and direction, time and date of exposure).
5. Methods for identifying the probable source when no specific source is suspected or there is more than one likely suspect, including personal knowledge or agency records (e.g., complaint files, plan review files, source test results).

Knowledge of the procedure for taking acceptable photographs of the physical evidence of air contamination or open burning violations. Photographs should be adequately focused, framed, and exposed.

Ability to elicit the cooperation of managers and operators of units to be inspected in order to gain access to the facility and to required company records	Coached Practice	Programmed Instruction/Group Problems Using Simulation
Ability to act upon a violation. This includes the following skills and knowledge:	Coached Practice	Programmed Instruction/Group Problems Using Simulation

Ability to identify or verify the specific section of local regulations which was allegedly violated as reported by enforcement personnel.

Ability to select an enforcement action which is appropriate for the specific type of violation or circumstances observed (e.g., ticket, warning).

Knowledge of the procedure for preparing a typical notice of violation. This includes knowledge of the rules for recording information and the appropriate wording for narrative portions of the notice.

Knowledge of the procedure for serving violation notices and for keeping appropriate records of such activities.

Ability to prepare correct, concise, factual, and legally acceptable reports typically required of the inspector. These include engineering or field reports and notices of violation	Tutored Practice	Individual Problems
Knowledge of the ethical considerations that impact on complaint handling and inspection. These ethical considerations include:	Exposure	Assigned Reading

1. Inspectors must not interfere with the acts or decisions of the control officer.
2. The law must be applied uniformly.
3. Recommendations for specific control equipment manufacturers are not permitted.
4. Information acquired about an operation or company is proprietary and must never be disclosed to competitors.
5. Inspectors (without the appropriate engineering background) will not make engineering recommendations.
6. No gratuities.
7. Be aware of personal biases and try to be factual and objective.
8. Do not promise any legal or agency actions which are not possible to carry out.
9. Maintain a neutral stance.

COURSE FREQUENCY

Course should be given as frequently as at present, or in response to demand. New course 3 Presentation of Expert Testimony should be scheduled to occur immediately following the conclusion of course 444.

COURSE LENGTH

The addition of the new skills and knowledge content will offset the elimination of the expert witness skills and knowledge. The course length can remain at three days, although increasing the course length to four days would be preferable.

PREREQUISITES

The prerequisite for this course is a knowledge of control technology at the level of 431 (for routine inspectors) or 413, 415 and/or 427 for plan review engineers. These courses should be exempted where the prospective trainee can pass a pretest (preferably self-administered and self-evaluated).

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439 Evaluation of Visible Emissions

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

Currently, the course intent is to certify agency personnel as smoke readers capable of judging visible emissions adequately, and to prepare students to conduct a smoke-reading course. No change in intent is required. The major course recommendation is to restructure the course into two levels. Level 1 would provide background and theory for new smoke readers and experienced smoke readers wishing to refresh or update their knowledge. Level 2 would emphasize acquisition of skill and certification (or recertification). For recertification Level 1 would not be required.

INTENDED AUDIENCE

Currently, nearly any occupational category from an agency is likely to take the course. In FY72, approximately 18 percent of the students were from industry. Familiarity with a typical agency organization and knowledge of legislated emission codes are assumed. No change in audience appears necessary.

COURSE GOALS

Currently, the course goals are to provide:

1. Ability to read smoke plumes within specified tolerances.
2. Knowledge of how to be an expert witness at a court hearing.
3. Knowledge and skills in basic meteorology as relevant to making smoke readings.
4. Knowledge of combustion principles, particularly coal and oil combustion.

5. Visual identification of emission source types.
6. Knowledge of what constitutes an adequate air pollution law.
7. Ability to state the elements of student's local (city, county, or state) visible emissions code.
8. Knowledge of the smoke generator, its parts and operational characteristics.

It is recommended that goal 2 be eliminated (to be covered in proposed New Course 3, "Presentation of Expert Testimony"). The following goal should be added:

9. Knowledge of procedures and techniques for conducting a course in smoke reading.

The coverage of goals by level is given below:

Level 1

Coverage should include goals 3, 4, 6, 7, 8, and 9.

Level 2

Coverage should include goals 1 and 5.

SKILL AND KNOWLEDGE COVERAGE

The skills and knowledge as described in the 439 Course Description (see Volume 1) are adequate. Some additions are recommended. The skill and knowledge coverage by level is given below:

Level 1

All of the skills and knowledge presently included in the course, except those specifically listed under Level 2 below, should be taught in Level 1. The following additional skills and knowledge should be included:

Skills and Knowledge	Teaching Level	Method/Media
Ability to plan the conduct of a training course for smoke readers. This involves the following skills and knowledge:	Tutored Practice	Lecture/Assigned Readings/Practice Exercises requiring trainee to structure a smoke reading course

Ability to identify and describe training requirements for information and skill in order to determine content areas to be covered in the course. This requires:

1. Identification and description of the tasks to be performed by the trainee on the job which are to be covered by the course.

2. Identification of the skills and knowledge required to effectively perform those tasks.

3. Identification of those required skills and knowledge not currently held by the trainees and, therefore, reasonable content areas for the course to attack.

The extent to which this skill is required depends upon the degree of freedom available to the school operator in designing the course.

Ability to prepare training objectives. These objectives should adequately describe the behavior and knowledge to be acquired, the conditions under which these behaviors will be employed on-the-job, and the performance levels the trainee must achieve to demonstrate competence.

Knowledge of the procedures for administering the smokeschool course. This includes knowledge of procedures for the following:

1. Opening comments

2. Coordinating guest instructors

3. Distributing materials as needed

4. Delivering lectures
5. Administering examinations and smoke-reading tests

6. Providing feedback

7. Maintaining the schedules

Knowledge of the types of content specialists who could contribute to the effectiveness of a training course by making presentations. These specialists could be selected from the agency, industry, or government officials.

Knowledge of the training materials and equipment available relevant to visible emissions and smoke reading.

Knowledge of the procedures and materials (e.g., response forms) used for practice and testing of smoke-reading with a smoke generator.

Ability to design and prepare training approaches, materials, lectures, visual aids, etc., required to enable trainees to achieve course objectives. Maximize characteristics including:

1. Cost/effectiveness
2. Job-relevance
3. Student involvement and participation

Knowledge of the procedures for scheduling training course class meetings. In setting up the schedule, consideration should be given to factors including:

1. Availability of required facilities and equipment
2. Availability of students
3. Availability of lecturers and guests

Ability to provide the type of feedback individual trainees require to support learning and performance in training or on-the-job. This includes providing the technical information or practice required to:

1. Answer questions
2. Alleviate confusion
3. Improve substandard learning or performance

Ability to prepare written and behavioral tests of the knowledge and skill trainees are to achieve in training.

Knowledge of recommenced procedures for maintaining records of student participation in a training program.

Ability to operate, calibrate, and maintain the smoke generator used in a smoke-reading course.

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Skills and Knowledge	Teaching Level	Method/Media
Knowledge of information sources relevant to background, theory, practices, and new developments in visible emissions evaluation	Exposure	Bibliography

Level 2

The following skills and knowledge, presently included in the course, should be taught in Level 2:

Items to record when reading emissions

Ringelmann Scale and its use

Equivalent Opacity

Meteorological considerations (review only - major coverage should occur in Level 1)

Ability to evaluate smoke, given 50 consecutive emissions, within the established parameters

Ability to correctly fill out a form reporting emission evaluation

Ability to correctly fill out a form reporting an emission violation

One skill should be added to the Level 2 coverage.

Ability to accurately and reliably read smoke density or opacity from mobile sources. This skill involves ability to accurately compensate for errors due to reading the smoke directly into the plume. The compensation factor used should vary as a function of the angle between the line of line of observation and the smoke trail	Coached Practice	Lecture/Slides/ Field Practice

COURSE FREQUENCY

Course should be offered as required, based on demand. New course 3 Presentation of Expert Testimony should be scheduled to immediately follow 439.

COURSE LENGTH

Levels 1 and 2

Total course length should remain at three days.

Level 2

Coverage of Level 2 content only should require one day.

PREREQUISITES

No formal course prerequisites are recommended. However, prospective agency trainees should be informed concerning the specific background knowledge they should have regarding agency organization and emissions codes, prior to their attending the course.

431 Air Pollution Control Technology

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

Currently, the intent of 431 is to teach potential (or actual) plant inspectors from control agencies the principles and design of control equipment. The intent should be broadened by adding emphasis on problems and techniques associated with the inspection of each type of control device.

The course should be packaged as is presently planned but divided into two levels. The instructional units in Level 1 should cover theoretical background with emphasis on theory and principles of operation of gaseous and particulate control devices. The Level 2 units should have a practical application emphasis. They should cover knowledge directly relevant to the inspection of control devices, boilers, and incinerators, and exercises designed to provide skill in making discriminations and performing procedures necessary to effective inspection.

Level 1 can be taken without Level 2, but students requiring Level 2 must first complete Level 1.

INTENDED AUDIENCE

Currently, the course is aimed for agency personnel who require information relative to inspection of plants for air pollution violations. The students are assumed not to have a college degree although at least half of the trainees in Fiscal 1972 did have degrees, most commonly in engineering.

Level 1

Nondegree agency inspectors, and other agency personnel who require a theoretical background on control devices, incinerators, and boilers (e.g., personnel working in air quality program planning and development).

Level 2

Nondegree agency inspectors performing structured routine inspections of control devices, boilers, and incinerators.

COURSE GOALS

Currently, course goals are to provide:

1. Coverage concerning control of particulate emissions, including what constitutes particulate sizing, and the devices used for control.
2. Coverage concerning control of gaseous emissions including the principles of absorption, condensation, combustion, and adsorption; and the devices used for control.
3. Coverage concerning odor measurement and its control.
4. Coverage of legislative developments in air pollution control.
5. Coverage of specific pollution sources including rendering plants, automobiles, the petroleum industry, asphalt batching, SO_X emissions, power plants, grain handling, cement plants, fertilizer plants, pulp and paper indsutry, iron and steel industry, metal foundries, and others.

It is recommended that the following goals be added:

6. Coverage of combustion principles and proper operating practices for new and existing combustion sources (including content relating to goals 2 and 7 in the present course 427 Combustion Evaluation, see Volume I).
7. Coverage of problems and techniques associated with the inspection of each type of control device including:
   a. Ways each can malfunction or operate at reduced efficiency.

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b. Symptoms of malfunction.

c. Common modes of incorrect operation.

d. Evidences of poor maintenance.

Level 1

Knowledge acquisition of goals 1 through 6.

Level 2

Knowledge acquisition of goal 7. Skill acquisition related to all goals with emphasis on the development of discriminations necessary to identify improper operation and maintenance of control devices, incinerators, and boilers.

SKILL AND KNOWLEDGE COVERAGE

Level 1

The knowledge statements presently included in the 431 Course Description (see Volume I) appear appropriate. It is recommended, however, that the teaching levels of each be increased to the familiarity level by means of group or individual problems requiring trainees to apply the concepts learned. Additional Level 1 knowledge should be provided as stated below.

Knowledge	Teaching Level	Method/Media
Importance of combustion evaluation	Familiarity	Lecture/Problems
Factors in combustion: time, temperature, oxygen, and turbulence	Familiarity	Film/Problems
Products and types of combustion	Familiarity	Lecture/Problems
Combustion-related terminology	Exposure	Assigned Reading
Basic design of burning equipment for gas, oil, and coal	Familiarity	Lecture/Problems
Types of incinerators for waste burning	Familiarity	Lecture/Problems
Basic design of waste burning incinerators	Familiarity	Lecture/Problems
Data sources for pollution-relevant process descriptions	Exposure	Bibliography

Organization of all but the last of these knowledge requirements into a largely self-administered module is recommended. This module could then be utilized as introductory material in 427 Combustion Evaluation for those trainees requiring such coverage.

Level 2

The following skills and knowledge should be covered in Level 2.

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of important inspection points on particulate control equipment and indications of malfunction, reduced efficiency, improper operations and/or poor maintenance at each point. The following equipment types would be included: Settling Chambers Drv Centrifugal Collectors Wet Collectors Electrostatic Precipitators Bag Houses and Fabric Filters	Familiarity	Lecture/Visual Aids/Problems
Ability to correctly identify above symptoms on each particulate control device covered	Coached Practice	Problems using Slide/Video/ Movie Presentation
Knowledge of important inspection points on gaseous control equipment and indications of malfunction, reduced efficiency, improper operation and/or poor maintenance at each point. Equipment types would be included utilizing each of the following principles of operation: Absorption Condensation Combustion Adsorption	Familiarity	Lecture/Visual Aids/Problems
Ability to correctly identify above symptoms on each gaseous control device covered	Coached Practice	Problems using Slide/Video/ Movie Presentations
Knowledge of good operating practice for gas, oil, and coal burning equipment including indications of malfunction, reduced efficiency, improper operation and/or poor maintenance	Familiarity	Lecture/Visual Aids/Problems

Skills and Knowledge	Teaching Level	Method/Media
Ability to correctly identify above symptoms for each type of burning equipment	Coached Practice	Problems using Slide/Video/Movie Presentation
Knowledge of good operating practice for waste incinerators including indications of malfunction, reduced efficiency, improper operation, and poor maintenance	Familiarity	Lecture/Visual Aids/Problems
Ability to correctly identify above symptoms for waste incinerators	Coached Practice	Problems using Slide/Video/ Movie Presentation

COURSE FREQUENCY

The course should be scheduled at its present frequency.

COURSE LENGTH

Level 1

Two days.

Level 2

Three days.

PREREQUISITES

The prerequisite for the course is the 422-A module on Control Techniques.

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413 Control of Particulate Emissions

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

The current intent of the course is to teach agency personnel to evaluate industrial plans for systems to control particulate emissions. The major recommendation is to broaden the scope of the course to teach private sector design engineers the basic principles of the design of effective particulate control systems. These design engineers may also need background in plan evaluation in order to review designs submitted by vendors or design consultants.

A greater emphasis should be placed on student exercises requiring the use of principles learned in actually designing and critiquing particulate control systems. Exercises could be developed to permit private sector students to design systems and agency students to critique them. Exercises should demonstrate practical problems and errors common to the design and review processes.

INTENDED AUDIENCE

The course is intended for B.S.-level engineers or non-engineers familiar with basic engineering concepts, terminology, mathematics, and drawing. A basic familiarity with particulate control devices is assumed (see Prerequisites). Plan review engineers are assumed to be familiar with the administrative procedure for plan review employed by their agencies, including the guidelines used to discriminate an acceptable from an unacceptable plan. Design engineers are assumed to be familiar with the industrial processes in their companies for which control is required.

COURSE GOALS

Current course goals are to provide:

1. Ability to list devices used to control particulate emissions, their characteristics in terms of operation and application, and their advantages and disadvantages.
2. Ability to evaluate the efficiency of particulate control equipment given operating parameters.
3. Ability to use basic fluid mechanics together with particle physics to predict the characteristics of particle movement.
4. Ability to determine particle sizes and particle size distributions by various techniques, and to be able to relate this knowledge by graphical means.

It is recommended that the following goals be added:

5. Ability to systematically identify and describe the critical process parameters affecting the selection of a particulate control device and to select and size a control device or combination of devices to produce the required abatement.
6. Ability to develop a control system design specification to satisfy typical agency plan review requirements.

SKILL AND KNOWLEDGE COVERAGE

The knowledge statements included in the 413 Course Description (see Volume I) appear adequate. The following skills and knowledge should be added, to the extent that they are not already included in the course.

Skills and Knowledge	Teaching Level	Method/Media
Ability to identify all emissions from a process for which control is required, and all sources of these emissions. This includes the following skill and knowledge:	Coached Practice	Programmed Instruction/ Readings/Group Exercises

Knowledge of the chemical and physical properties of materials used in the process being reviewed which have an effect on emissions and possible air pollution.

Ability to identify and describe the air contaminants likely to be emitted by a unit of basic equipment. The description should be in terms such as:

1. Temperature, volume, and velocity of the gas stream
2. Probable particle size range and frequency distribution
3. Odor
4. Chemical composition

Knowledge of the specific practices and processes of the type of industry being reviewed which may contribute to air pollution, for example:

1. In a refinery, rattling and blowing coke from cracking tubes.
2. In metal melting, the air pollution effects of efforts to remove metal impurities during the melt process.

Ability to estimate amount of emissions from a process. This includes the following skills and knowledge:	Coached Practice	Programmed Instruction/ Readings/ Group Exercises

Knowledge of the basic procedures used in estimating source emissions from information describing the process, its production rates, production schedules, types of contaminants emitted, or the emission control devices currently in service or proposed. These procedures should include use of emission factors, materials balance, and source test finding.

Ability to use published emission factors to estimate emissions.

Ability to use materials balance techniques to estimate emissions.

Ability to estimate emission factors when no published factors are available. These estimates will be based on source test findings, and engineering assumptions from consideration of situational factors such as:

1. Escape effluent potential
2. Efficiency of burning
3. Amount of exhaust gas

4. Quantities of input material

5. Temperature of operations

Ability to conceptualize, size, configure, and produce rough drawings and specifications for a system to control particulate emissions. This includes the following skills and knowledge:	Coached Practice	Programmed Instruction/ Readings/Group Exercises

Ability to apply appropriate standard engineering and design analyses, principles, and resource data, to prepare detailed design data for an air pollution control system. The system may include:

1. Process equipment, including operation controls

2. An emission collection and exhaust system

3. Modifications to basic process equipment

4. Air cleaning equipment

Included is the ability to produce flow diagrams, schematics, and mechanical drawings.

Ability to predict how the load requirements on a control device will change with time, so that designs can be selected which have the greatest productive longevity.

In evaluating basic, control, or ventilation equipment, the ability to recognize trade-offs. That is, the design of a piece of equipment may lack one desirable characteristic but be able to make up for it with another characteristic. For example, if agglomeration is likely in a particular baghouse installation, shaking techniques and cycle may be judged adequate to counter the caking effect of the effluent.

Ability to prepare performance and equipment specifications which clearly and completely define all design requirements.

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Skills and Knowledge	Teaching Level	Method/Media
Ability to evaluate a proposed design for a particulate control system. This includes the following skills:	Coached Practice	Programmed Instruction/ Readings/Group Exercises

Ability to apply the appropriate standard engineering analyses, principles, and resource data to the evaluation of the proposed basic equipment, ventilation system, or control device using typical agency plan review/permit processing procedures.

Ability to accurately judge whether or not the general type of control device(s) (e.g., baghouse, wet scrubber) selected by the applicant in a permit application is well-suited to the characteristics of the contaminants likely to go through it. If the applicant's choice is inferior to some other type of device, the reviewer should be able to make note of the more desirable selection and the rationale for that judgment. In making the judgment consider factors including:

1. Efficiency as a function of particulate size and weight.
2. Possible physical or chemical attack by the contaminant on the device (including impairment of function due to moisture).
3. Possibility of transforming the pollution problem rather than solving it completely (e.g., creating a water pollution problem as a result of treating an air contaminant, or creating an odor problem with the collection device).
4. Only partially eliminating the pollution problem (e.g., cleaning the particulate element of the effluent without treating the odorous element).

Ability to estimate control equipment costs on an air volume basis.

Knowledge of sources of information providing detailed design and evaluation-relevant information in the following areas: 1. Processes 2. Control Devices 3. Ventilation Systems	Familiarity	Bibliography/ Practice in Using Source Data Provided in Other Student Exercises

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the plan review and permit system. This includes the following knowledge:	Familiarity	Self-Instructional Module with Exercises Taken at the Option of the Trainee

Knowledge of the basic objectives for a plan/permit review system.

Knowledge of typical types of plan/permit review systems.

Knowledge of steps involved in obtaining a permit to construct and operate pollution source equipment.

Knowledge of information included in request (application) for permit to construct or operate.

COURSE FREQUENCY

Schedule course according to demand.

COURSE LENGTH

The course length could be reduced to four days, as proposed by APTI.

PREREQUISITES

1. A B.S. in engineering or a strong engineering background (see Intended Audience).
2. 422-A module on control devices or 431 Level 1.

These prerequisites should be exemptable following successful completion of a pretest (preferably self-administered and self-evaluated). The prospective trainee should be informed concerning the need to have background in agency plan review procedures (for plan review engineers) or control-relevant processes (for design engineers). The specific knowledge requirements should be described.

415 Control of Gaseous Emissions

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

It is recommended that 415 be structured in parallel with 413 Control of Particulate Emissions in the sense that it provide training both in the evaluation of control systems (as is presently the intent) and in the design of these systems (as needed by private-sector system design engineers). Thus 415 should cover both the evaluation and design of gaseous control systems. The recommendations in all areas (i.e., General Course Description, Intended Audience, Course Goals, Skill and Knowledge Coverage, Course Frequency, Course Length, and Prerequisites) are basically similar for both courses and are not repeated here. The detailed recommendations are provided in the subsection describing 413.

427 Combustion Evaluation

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

There are no major content modifications recommended for this course. However, emphasis of the presentations should be on development of the skills and knowledge needed to prepare and review plans for combustion-involved permit applications. This emphasis, already a major course intent, is recommended in conjunction with de-emphasis of the skills and knowledge needed for inspection of in-place combustion systems. In order to provide this de-emphasis, inspection skills and background in combustion practices have been placed in 431 Air Pollution Control Technology, and a de-emphasis on goals 2 and 7 in 427 is recommended.

In-depth coverage of combustion principles, required by both potential audiences (inspectors and engineers), and not covered in 431 due to time constraints, can be provided early in 427. In this way, inspectors can complete their training in the first two days and leave the course. Engineers, who also need the in-depth combustion principles coverage, will not have lost training time and will be ready to proceed with permit application preparation (design engineers) and review (plan review engineers) at the end of the same two days.

INTENDED AUDIENCE

The course is intended for B.S.-level engineers or non-engineers familiar with basic engineering concepts, terminology, mathematics, and drawing.

Plan review engineers are assumed to be familiar with the administrative procedure for plan review employed by their agencies, including the guidelines used to discriminate an acceptable from an unacceptable plan. Design engineers are assumed to be familiar with the industrial processes in their companies for which control and/or evaluation is required.

COURSE GOALS

Current course goals are to provide:

1. Knowledge of combustion principles.
2. Knowledge of good combustion practices.
3. Knowledge of combustion sources burning specified fuels.
4. Knowledge of combustion control devices.
5. Ability to perform calculations associated with determining fuel requirements.
6. Ability to review plans for combustion systems.
7. Ability to evaluate combustion practices and recommend proper operation practice for new and existing combustion sources.

It is recommended that goals 2 and 7 be eliminated.

SKILL AND KNOWLEDGE COVERAGE

The knowledge statements listed in the 427 Course Description (see Volume I) appear to be adequate except that content relating to good operating practices should be de-emphasized (these skills and knowledge are recommended for coverage in 431 Air Pollution Technology). Skills and knowledge relating to permit application preparation and review should be added. A suggested list of these skills and knowledge is provided in 413 Control of Particulate Emissions.

COURSE FREQUENCY

Schedule course according to demand.

COURSE LENGTH

Total course length: four days

Course length for inspectors: two days

PREREQUISITES

1. A B.S. in engineering or a strong engineering background (see Intended Audience).
2. 431 combustion practices module.

450 Source Sampling

Engineering and Enforcement Section

GENERAL COURSE DESCRIPTION

Currently the course intent is to teach students the equipment and procedures to use to take samples of stack gases under various conditions. While this intent is generally adequate it does not take into consideration the diversity of purposes to be served by a source sampling course. The course is presently being packaged for use by non-content-expert instructors in a form minimizing the use of the lecture method and emphasizing self-instruction. It is recommended that three course levels be defined within this form, each with the following intent:

Level 1, providing basic knowledge background in source sampling as would be required by a test observer to critique the conduct and results of a test. Level 1 would also serve as a course introduction to the other trainees.

Level 2, providing the theory and technical background required for planning and supervising a stack test.

Level 3, providing skills necessary to actually perform a stack test.

Persons interested in test observation would take only Level 1; persons having responsibility for planning and supervision would take Levels 1 and 2 as a minimum; technicians actually performing stack tests would elect Levels 1.and 3.

The course as structured can serve equally well the needs of public and private sector personnel.

INTENDED AUDIENCE

Levels 1 and 3

The intended audience for Levels 1 and 3 would be both engineers and technicians. The trainee is assumed to have orientation level knowledge concerning his agency and/or company policies and procedures regarding stack testing, and the general role of stack testing in air pollution. The minimum level of formal education of trainees can be assumed to be high school graduate. The trainees should have a minimum level of technical skill (see Prerequisites).

Level 2

Bachelor's level or better engineers and chemists are the intended audience for Level 2. Agency trainees can be assumed to have a high level of knowledge concerning agency stack test related activities, policies, organization, and techniques. Private sector trainees will be familiar with emissions related company processes.

COURSE GOALS

The recommended goals for each course level are given below.

Level 1

The goals for Level 1 are to provide:

1. Basic knowledge of the reference procedure for a stack test.
2. Knowledge of acceptable variations of the reference stack testing procedure and their advantages of disadvantages, including problems in their accuracy and precision.
3. Knowledge of common errors and difficulties associated with stack testing, the inaccuracies that result, and how they can be avoided.
4. Knowledge of what constitutes complete, precise, and accurate reporting of stack test results.

Level 2

This level should provide:

1. Detailed knowledge of the reference method for stack testing, including theoretical background and all required formulas.
2. Ability to plan a stack test including pretest planning and preparation.
3. Ability to conduct a stack test, including making work assignments.
4. Ability to prepare a report of the stack test including interpretation of results.

Level 3

Level 3 goals should be to provide:

1. Ability to perform all steps of a stack test, using the reference method and selected acceptable variations.
2. Knowledge of all important accuracy and safety precautions attending each step in the procedure.
3. Ability to perform all required calculations.

SKILL AND KNOWLEDGE COVERAGE

The skills and knowledge as described in the 450 Course Description (see Volume I) appear adequate although additional skills and knowledge are recommended. A classification of new and existing skills and knowledge statements according to the level in which they should be covered is described below.

Level 1

The following skills and knowledge should be included in the Level 1 coverage:

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the detailed procedure for conducting the stack sampling. This includes knowledge of the technique for: 1. Inserting the probe 2. Operating sampling apparatus 3. Moving the probe from one point to another 4. Recording times, temperatures, pressures, meter rates, etc. 5. Removing the probe without losing or contaminating any of the sample	Familiarity	Film or Videotape/Exercises
Knowledge of the proper technique for measuring the temperature of stack gases	Familiarity	Film or Videotape/Exercises
Knowledge of the procedure for measuring the static pressure inside a stack	Familiarity	Film or Videotape/Exercises

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the procedure for accurately positioning a pitot tube or sampling probe at each of the traverse or sampling points	Familiarity	Film or Videotape/Exercises
Knowledge of the nomenclature, configuration, and function of the apparatus to be used in collecting stack gas flow data, particulate samples, and gaseous samples. This equipment includes: 1. Pitot tubes (standard, type S) 2. Sampling probe (e.g., heated type) 3. Sampling nozzle (e.g., gooseneck nozzle) 4. Filter holders and filters (e.g., Alundum thimble, flat filter, packed tube type) 5. Condenser/impingers (e.g., Greenburg-Smith type) 6. Pressure gauges (e.g., inclined manometer, micromanometer, thermo-anemometer, vane anemometer) 7. Thermometers (e.g., shielded or unshielded thermocouples and a potentiometer, standard mercury bulb thermometer) 8. Dry test meter 9. Pump (e.g., rotary or positive displacement type) 10. Aspirator 11. Rate meters (e.g., gas flowmeters, orifice meters, rotameter) 12. Orsat apparatus	Familiarity	Programmed Instruction/ Exercises
Knowledge of the alternative methods available for collecting gas flow data, assembling the sampling train, collecting the sample, and transporting/handling the sample prior to analysis	Familiarity	Lecture/Group Discussion
Knowledge of the meaning of the following terms which are used in the evaluation of a method: 1. Validity 2. Reliability 3. Accuracy 4. Precision	Exposure	Reading

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of stack test procedure sufficient to: 1. Identify errors possible in each step of the procedure and their effect on the final outcome of the analysis 2. Identify critical steps in the procedure. A critical step is one in which: (a) Errors are known to frequently occur (b) Little margin for error exists (c) Errors are likely to go undetected 3. Revise the procedure so as to reduce the possibility of error	Familiarity	Film or Video Presentation/ Exercises
Knowledge of the information required and the presentation format for reporting the results of a stack test	Familiarity	Programmed Instruction/ Exercises
Ability to discriminate errors in the performance of a stack test	Coached Practice	Film or Video Simulation Exercises
Ability to discriminate incorrect statements, errors, and omissions in a report of a stack test	Coached Practice	Exercises Using Example Reports

Level 2

Level 2 skills and knowledge should include all knowledge statements in the 450 Course Description except the following, which are covered in Level 1:

Equipment used in sampling trains

Alternate sampling techniques

Ways to interpret sampling data

The following additional skills and knowledge should be included in Level 2:

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the industrial process and stack gases to be sampled. Important information might include: 1. Cyclic or steady state nature of the process	Exposure	Lecture/ Bibliography/ Exercises

Skills and Knowledge	Teaching Level	Method/Media
2. Feed composition and rate 3. Fuel rate 4. Gas volume 5. Operating temperatures and pressures 6. Toxic conditions 7. Schedule of operation 8. Control equipment 9. Expected type of emission 10. Stack dimensions This includes knowledge of available sources of such data.		
Knowledge of the effects on stack gas particulate concentration resulting from each of the following stack characteristics: 1. Changes in direction 2. Horizontal duct 3. Fans 4. Vents 5. Change in the shape of the stack	Familiarity	Lecture/Readings/Exercises
Knowledge of the procedure for subdividing a circular, rectangular, or irregularly-shaped stack cross-section into a given number of equal area zones. This includes knowledge of the procedure for calculating the equivalent diameter of a rectangular stack	Familiarity	Lecture/Readings/Exercises
Knowledge of the alternative components of a stack sampling train and the knowledge of the appropriate use conditions (i.e., advantages/disadvantages) for each component and its alternatives. This knowledge includes the following alternatives: 1. Lubrication for threads on all connections (a) TFE--fluorocarbon tape (temperature below 500°F) (b) Powdered graphite (temperature greater than 500°F)	Familiarity	Lecture/Readings/Exercises

Skills and Knowledge	Teaching Level	Method/Media
2. Pitot tubes for velocity measurements (a) Standard pitot tube (b) Type S (c) Orifice disc (for relatively small pipes or ducts) 3. Manometers (a) Inclined manometers (gas velocity greater than 400 ft./min.) (b) Micromanometer (gas velocity less than 400 ft./min.) (c) Thermo-anemometer (very low velocities) 4. Temperature indicators (a) Standard thermocouples and potentiometer (shielded type for temperature above 700°F) (b) Standard mercury bulb thermometer 5. Filtering media (a) Alundum thimble (used when high wet strength, chemical resistance, or high temperature resistance is required) (b) Paper thimble (used when temperatures and suction pressure, moisture content, and dust loadings are anticipated to be low) (c) Glass fiber filters (used when gas stream contains liquid droplets and heavy dust loadings) (d) Membrane filters (used for extremely small particles) (e) Tar cameras		
Knowledge of commercially available sampling equipment and materials. These items are described in manufacturers and suppliers catalogs	Exposure	Demonstration/ Readings
Knowledge of the procedure for determining the correction factor for a type S pitot tube	Familiarity	Readings/ Programmed Instruction/Lecture/Exercises

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the formulae used to perform the calculations required prior to, during, and after the sampling period. These calculations may include: 1. Average stack gas velocity 2. Stack gas volumetric flow rate 3. Sampling rate required to achieve isokinetic sampling 4. Dry gas volume 5. Proportion by volume of water vapor in gas stream 6. Concentration of particulate matter in stack gas (gr./SCF and lb./cu. ft.) 7. Isokinetic variation	Exposure	Readings/ Programmed Instruction/ Lecture/ Exercises
Knowledge of methods used for making on-site modifications to the sampling equipment. Such modifications include: 1. Changing probe nozzles 2. Changing filters	Familiarity	Readings/ Programmed Instruction/ Lecture/ Exercises
Knowledge of the requirements for scaffolding to provide adequate space and strength to support sampling activity and equipment. One rule of thumb is to provide about three feet of platform working space on each side of the port and at least one stack or duct diameter plus three feet outward from the stack	Exposure	Readings/ Programmed Instruction/ Lecture/ Exercises
Knowledge of the preliminary and/or precautionary activities to be performed prior to or during sampling. These activities include: 1. Checking manometer, tubing, and connections for leaks 2. Leveling the manometer zeroing the liquid column and freeing it of bubbles 3. Adjusting the pitot tube length so that it can be handled easily outside the stack when held at a traverse point	Exposure	Readings/ Programmed Instruction/ Lecture/ Exercises

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Skills and Knowledge	Teaching Level	Method/Media
4. Sealing sampling ports as tightly as possible when taking velocity head readings to minimize the effect of static pressure. This is particularly necessary when an S-type pitot tube is used		
Knowledge of the procedure for draining the sampling train of moisture and measuring the condensate	Exposure	Readings/Programmed Instruction/Lecture/Exercises
Knowledge of the procedure for calculating the size of the sampling nozzle required	Exposure	Readings/Programmed Instruction/Lecture Exercises
Basic knowledge of the laboratory procedures for determining the chemical composition (percent CO_2, CO, O_2, and N_2) of stack gas	Exposure	Readings/Programmed Instruction/Lecture/Exercises
Knowledge of the effects of the sampling process on the nature of the sample collected. These effects may include: 1. Interference effects of stack gas constituents 2. Transformations in contaminant characteristics as a function of collection method (e.g., change from gaseous state in stack to particulate in collection process) 3. Creation of contaminants by sampling process (e.g., SO_2 in gas stream, process collects SO_3 or H_2SO_4)	Exposure	Readings/Programmed Instruction/Lecture Exercises
Knowledge of the chemical, electrical, and mechanical principles of operation of the various stack test instruments sufficient to: 1. Indentify instrument malfunctions which could go undetected and result in inaccurate read-out (to the extent not already documented in existing service manuals) 2. Develop procedures for the	Exposure	Readings/Programmed Instruction/Lecture Exercises

Skills and Knowledge	Teaching Level	Method/Media
timely discovery of such malfunctions 3. Identify the effects of incorrect instrument operation on instrument read-out		
Ability to effectively communicate and cooperate with plant operations and maintenance personnel in planning or administering the test. For example, the planner may wish to collect data concerning the process feed rate, gas volumes, fuel rate, and temperatures in order to determine factors such as sampling location and the test duration. In administering the test, the test supervisor may wish to make arrangements with operating personnel to maintain process conditions at a given level for enough time to complete the test	Tutored Practice	Group Exercise
Ability to select the sampling location which best approximates the following optimal conditions: 1. Distance of at least eight stack diameters downstream and two diameters upstream of any obstructions, e.g., bends, fans, vents 2. Vertical, rather than horizontal, duct 3. Ample room for test personnel and use of apparatus 4. Access to electrical power or compressed air 5. Ample lighting and/or shelter for extended sampling periods 6. Sample collected accurately reflects the emissions reaching the atmosphere	Coached Practice	Problems
Ability to establish the number of required sampling points taking into consideration factors including: 1. Proximity of the sampling location to any stack conditions which might cause abnormal particulate stratification	Coached Practice	Problems

Skills and Knowledge	Teaching Level	Method/Media
2. Size and shape of the stack. When sampling in an irregularly shaped flue, the flue must be divided into equally shaped areas and measurements made at the centroid of those areas 3. Gas velocity, volume, and turbulence 4. Process characteristics (e.g., duration of process cycles during which emissions reach maximum levels)		
Ability to design a sampling train which is appropriate for a specific test with regard to the following criteria: 1. Stack temperature (e.g., use of a shielded thermocouple in high-temperature conditions) 2. Particle size 3. Moisture content of gas (e.g., use of an S-type pitot tube when it is judged that a standard tube might clog up) 4. Corrosive nature of the gas 5. Type of analysis to be performed 6. Gas velocity (e.g., use of an ultrasensitive micromanometer when velocity is too low for use of a standard inclined manometer)	Coached Practice	Problems
Ability to choose a sampling time length and flow rate in accordance with requirements for sample reliability and representativeness and to avoid overloading the capacity of the various reagents, filters, traps, etc., in the sampling train	Coached Practice	Problems
Ability to accurately perform the calculations required prior to, during, and after the sampling period. These calculations may include: 1. Average stack gas velocity 2. Stack gas volumetric flow rate	Coached Practice	Problems

Skills and Knowledge	Teaching Level	Method/Media
3. Dry gas volume (at standard conditions) 4. Proportion by volume of water vapor in gas stream 5. Concentration of particulate matter in stack gas (gr./SCF and lb./cu. ft.) 6. Isokinetic variation		
Ability to make work assignments and coordinate the efforts of all personnel performing the stack test	Coached Practice	Problems
Ability to develop work procedures which provide detailed step-by-step guidance in the performance of the stack test	Coached Practice	Problems
Ability to document all procedures, findings, ideas, and decisions in writing which communicates clearly and completely to the intended audience	Coached Practice	Exercises requiring the writing of a report
Ability to cooperate with laboratory personnel in planning tests so as to assure proper coordination of analysis and sample collection activities	Coached Practice	Problems

Level 3

Level 3 skills and knowledge should include all of the skill statements in the Course Description and the following additional skills and knowledge:

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of precautions that must be taken with regard to hazards, such as platform height, high temperature of stack and gases, and electrical charges. This includes knowledge of the appropriate protective equipment, including: 1. Long-sleeved shirt 2. Hard hat 3. Safety shoes 4. Safety glasses 5. Gloves (standard weight and asbestos) 6. Gas mask	Exposure	Lecture/ Readings/ Exercises

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Skills and Knowledge	Teaching Level	Method/Media
Also, it is advisable to electrically ground the probes which are inserted in flues following electrical precipitators.		
Ability to assemble sampling apparatus with each component in proper sequence, using butt-to-butt connections, tygon tubing, and silicone or fluorocarbon grease as appropriate to create a leak-proof assembly	Coached Practice	Field Practice
Ability to operate sampling apparatus, making quick and accurate adjustments in flow control devices in order to maintain a predetermined sample flow rate and terminating the sampling process precisely at a predetermined time. In addition, this capability includes: 1. Accurately placing the pitot tube at the proper positions within the flue for each traverse 2. Careful handling of collected samples so that contamination or loss of sample material is avoided 3. Quick and accurate use of nomographs which support adjustment of sampling rate without the need for other computations	Coached Practice	Field Practice
Ability to read indicating devices, such as a thermometer, manometer, dry gas meter, flowmeter, and barometer, and to interpret meter readings against a calibration plot as required	Coached Practice	Field Practice
Ability to read and interpret data from tables, charts, and/or nomographs. Examples of these materials include: 1. Tables of equal area zones for velocity traverse in round ducts	Coached Practice	Field Practice

Skills and Knowledge	Teaching Level	Method/Media
2. High temperature psychometric chart for air-water vapor mixtures at one atm. 3. Tables of vapor pressures of water 4. Chart of orifice disc factors as a function of the ratio of orifice and pipe diameter 5. Nomographs used in determining the meter rate		
Ability to accurately read, operate, calibrate, and otherwise maintain the instruments required for measuring the velocity pressure, static pressure, temperature, moisture content, and composition of stack gases. These instruments include: 1. Standard and/or type S pitot tubes 2. Inclined manometer 3. Draft gauge 4. Micromanometer 5. Thermo-anemometer 6. Vane anemometer 7. Thermocouple and potentiometer 8. Mercury bulb thermometer 9. Water gauge manometer 10. U-tube mercury manometer 11. Wet- and dry-bulb thermometers 12. Condensing equipment 13. Orsat apparatus	Coached Practice	Field Practice

COURSE FREQUENCY

The course should be offered as often as demand dictates. Also depending upon demand, selected levels of the course could be offered by themselves, i.e. Level 1 alone, Levels 1 and 2 only, and Levels 1 and 3 only.

COURSE LENGTH

Level 1

Level 1 would require one day.

Level 2

Level 2 would require two days.

Level 3

The content of Level 3 should be covered in two days.

PREREQUISITES

There are no formal prerequisites for course 450, although a prospective trainee for any course level should be supplied with a description of the kinds of background knowledge relevant to his agency or company he will be assumed to have upon entering the course (see Intended Audience).

Introduction to Air Quality Management Section

The courses presented by this section, with the exception of 452, are currently developmental, and 452 itself is undergoing major revision. As the section title indicates, these courses are aimed at management-level personnel, with the emphasis on organizing and managing an air pollution control agency.

The recommendations included in this section are intended to provide a unified curriculum for this intended audience with a minimum of overlap between courses. Special attention has been given to making these courses maximally helpful to higher-level management personnel.

The courses described with recommendations and suggested course modifications are:

452 Principles and Practice of Air Pollution

456 Regional Planning and Air Quality

457 Public Communications

458 Air Pollution Administration

In addition, two new courses are proposed. They are:

2 Air Quality Program Development

3 Presentation of Expert Testimony

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452 Principles and Practice of Air Pollution Control

Air Quality Management Section

GENERAL COURSE DESCRIPTION

It is recommended that the intent of 452 be to provide technical-level orientation toward:

1. Definition and description of agency activities.
2. Definition and description of various agency occupational categories (Engineer, Chemist, Inspector, etc.) and their interaction in performance of agency activities.
3. Definition and description of air pollution topics, developing from the basic content of 422-A to include recent developments and timely issues likely to affect agency purpose, direction, policies, and activities.

The major recommendation relates to reduction of present course content, and addition of new material to effect an overall reduction of course length to five days.

Since this course is to provide up-to-the-minute (and, therefore, often changing) coverage of new developments in air pollution, the instructional methods employed in many units will have to be selected for ease of modification. Lectures (including videotaped lectures) may be used for these units, provided they are clearly and simply presented, free of extraneous detail, paced to the intended audience, presented in a polished manner, and reasonably brief. Long presentations can sometimes be divided into short (e.g., 15 to 20 minute) segments with intervening group discussions.

INTENDED AUDIENCE

The course should be aimed at newly hired professional-level agency personnel. A professional-level agency employee will normally have a B.S.

or better in Engineering, Chemistry, Meteorology, Business, or other agency-related career fields. Such an employee will normally occupy a position from which advancement to higher agency management positions is generally possible. Basic orientation in air pollution topics can be assumed (see prerequisites).

COURSE GOALS

Current goals are to provide:

1. Knowledge of the jargon used in air pollution control.
2. Knowledge of the effects of air pollution on the environment.
3. Knowledge of the primary air pollution control methods.
4. Knowledge of the legal framework for air pollution control.
5. Knowledge of methods of measuring air pollution.

Recommended goals would incorporate the above, and add at least the following:

6. Knowledge of typical-agency patterns of organization, agency positions and their responsibilities, typical agency goals, source and extent of authority, and sources of funds and budgetary constraints.
7. Knowledge of principles and practice in the development of:
    a. Effective enforcement systems utilizing plan/permit review, source testing, and inspection.
    b. Continuous monitoring of sources, including recording and reporting of emissions data.
    c. Automated air-quality monitoring and reporting systems.
    d. Data storage-and-retrieval systems.

8. Knowledge of trends in law and technology, and their implications for agency functioning.

SKILL AND KNOWLEDGE COVERAGE

Based on analysis of Behavioral Objectives--Course 452 Principles and Practices of Air Pollution Control, as provided by the Air Quality Management Section, the following skill and knowledge coverage recommendations can be made.

The following lessons should be eliminated or de-emphasized, as indicated:

Lesson Title	Suggested Action
Implementation Plan (STEP)	Reduce time spent to 2 hours. Have trainees critique and discuss typical implementation plans
Legal Authority and Administrative Procedures in Air Pollution Control	Reduce time spent to 1 hour
Seminar, Legislation, Air Quality Standards and Criteria	Reduce time spent to 1-1/2 hours
Courtroom Procedure: An Expert Witness	Eliminate
Atmospheric Dispersion and Air Pollution Control, Meteorological Instrumentation and Exposure, and Air Pollution Climatology and Forecasting	Combine into one lesson with 2 hours allotted time
Influence of Topography	Eliminate
Wind and Air Pollution Roses	Eliminate
Reading Visible Emissions	Eliminate
Control Technique-Related Lessons	Reduce time spent by 50%
Source Sampling-Related Lessons	Reduce time spent by 50%
Calibration of Particulate and Gaseous Sampling Equipment	Eliminate
STEP Trial and Trial Preparation	Eliminate

The following skills and knowledge should be added or covered with increased emphasis:

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of EPA missions, organization, and activities	Familiarity	Programmed Instruction/Readings/Group Discussion/Exercises
Knowledge of typical state-level control agency missions and activities	Familiarity	Programmed Instruction/Readings/Group Discussion/Exercises
Knowledge of typical local control agency mission, organization, positions, and activities	Familiarity	Programmed Instruction/Readings/Group Discussion/Exercises
Knowledge of the principles and practice of effective enforcement, utilizing plan permit review, source testing, and inspection	Familiarity	Programmed Instruction/Readings/Group Discussion/Exercises
Knowledge of continuous monitoring of sources (i.e., background, current principles and practices, and future trends). This includes the requirement for recording and reporting of emissions data	Familiarity	Programmed Instruction/Readings/Group Discussion/Exercises
Knowledge of the state-of-the-art principles and practices in automated air-quality monitoring and reporting systems	Familiarity	Programmed Instruction/Readings/Group Discussion/Exercises
Knowledge of the state-of-the-art principles and practices in data-storage-and-retrieval	Familiarity	Programmed Instruction/Readings/Group Discussion/Exercises
Knowledge of current trends in federal, state, and local legislation and regulations, and their implications for agency functioning	Exposure	Readings/Guest Lecture (could be videotaped)/Group Discussion
Knowledge of current trends in control technology for module and stationary sources, and their implications for meeting air-quality standards	Exposure	Readings/Guest Lecture (could be videotaped)/Group Discussion

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COURSE FREQUENCY

The course should be scheduled according to student demand.

COURSE LENGTH

The course, as modified, could be presented in five days.

PREREQUISITES

Trainees for 452 should have taken 422-A Air Pollution Control. This requirement could be exempted by means of a pretest (preferably self-administered and self-evaluated).

456 Regional Planning and Air Quality

Air Quality Management Section

GENERAL COURSE DESCRIPTION

The recommended course 456 combines the content and intents of 455 Air Pollution Principles for Planners and the present course 456 Regional Planning for Air Pollution Control Officers. A modularized approach is recommended so course presentation can be tailored to the needs of both planners and agency personnel. The course intent is to develop a working relationship between planning personnel and agency personnel, by providing each with a basic background in the other's area of expertise. A combined course fosters development of a working relationship by (a) combining common information from both viewpoints, and (b) providing access to each other's point of view. To assist the development of this relationship, it is suggested that all students (planning-agency personnel and control-agency personnel) develop skill in both preparing and critiquing environmental-impact statements.

For presentation of topics that diverge for the two audiences, self-directed course modules should be developed utilizing videotape, illustrated audio-tape, and/or self-administered exercises. Modules for presentation to both audiences may be entirely self-directed, or they may be partly self-directed and supplemented by special-topic lectures, group exercises, the currently utilized panel discussions, or other appropriate presentations. All modules could be packaged for use in the field.

This combined-course approach differs from the one described in the preliminary course modification recommendations, and is proposed on the basis of new information provided by APTI staff.

INTENDED AUDIENCE

Urban planning agency personnel

Transportation planning agency personnel
Control agency personnel

COURSE GOALS

Control Agency Personnel Only

1. Knowledge of basic land use and transportation-planning concepts.

Urban and Transportation Agency Personnel Only

1. Knowledge of basic air pollution and air pollution-control concepts.

Both Audiences

1. Knowledge of the relationship between land use and air pollution, including meteorological analysis.
2. Knowledge of land use and transportation planning strategies which can minimize or prevent air pollution problems.
3. Skill in preparing and critiquing environmental-impact statements.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list of skills and knowledge and suggested modules, based on analysis of existing courses and stated APTI-staff development intents. The final list should be prepared by subject-matter experts to reflect the state-of-the-art and to ensure completeness.

Control Agency Personnel Only

Knowledge	Teaching Level	Method/Media
Knowledge of the present status of planning regulations and their impact on planning	Exposure	Lecture/Assigned Reading
Knowledge of the elements of transportation planning	Familiarity	Illustrated Lecture/ Assigned Reading/ Discussion or Exercise

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Knowledge	Teaching Level	Method/Media
Knowledge of the elements of regional planning	Familiarity	Illustrated Lecture/ Assigned Reading/Discussion or Exercise
Knowledge of the elements of urban planning	Familiarity	Illustrated Lecture/ Assigned Reading/Discussion or Exercise
Knowledge of mass and rapid transit factors and transportation systems	Exposure	Illustrated Lecture
Planning Agency Personnel Only		
Knowledge of the effects of air pollution	Exposure	Lecture/Assigned Reading
Knowledge of basic aspects of meteorology and its relation to air pollution	Familiarity	Lecture/Reference Materials/Exercise
Knowledge of air-quality management and control-agency activities	Exposure	Lecture/Assigned Reading
Knowledge of sources of air pollution	Familiarity	Lecture/Reference Materials/Illustrations
Knowledge of control approaches for gases and particulates in general, stationary sources, and mobile sources	Exposure	Lecture/Assigned Reading
Knowledge of administrative techniques for planners	Familiarity	Lecture/Exercise
Both Audiences		
Knowledge of current applications of planning to air-quality management	Exposure	Lecture/Reference Materials
Knowledge of ways to minimize or prevent air pollution by transportation planning	Familiarity	Lecture/Discussion

Knowledge	Teaching Level	Method/Media
Knowledge of ways to minimize or prevent air pollution by urban planning	Familiarity	Lecture/Discussion
Knowledge of ways to minimize or prevent air pollution by regional planning	Familiarity	Lecture/Discussion
Knowledge of air pollution dispersion and its interrelationships with transportation, urban land use, and regional land use	Familiarity	Lecture/Discussion
Knowledge of climate and its relationship to land use	Familiarity	Lecture/Discussion
Knowledge of the uses of dispersion modeling	Exposure	Lecture/Reference Materials
Knowledge of the elements of environmental-impact statements	Application	Moderated Exercises
Ability to produce environmental-impact statements for selected situations	Coached Practice	Moderated Exercises
Ability to critique selected environmental-impact statements	Coached Practice	Moderated Exercises

Suggested Training Modules

Control Agency Personnel Only

Introduction to Planning

Planning Personnel Only

Introduction to Air Pollution Control

Administrative Techniques for Planners

Both Audiences

Air Quality and Transportation

Air Quality in the Urban Setting

Air Quality in the Regional Setting

Environmental Impact Statements

COURSE FREQUENCY

Schedule periodically throughout the year, and upon request.

COURSE LENGTH

Three days

PREREQUISITES

Planning Personnel: None.

Agency Personnel: 422-A Air Pollution Control, or at least six months experience in a control agency.

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457 Public Communications

Air Quality Management Section

GENERAL COURSE DESCRIPTION

Currently the aim of this course is to provide the skills and knowledge required for maintaining effective two-way communication between the agency and government, industry, special interest groups, and the general public. This aim appears to be adequate. The course is presently under development and little formal documentation presently exists concerning its structure and content. Recommendations are based on what information was available, including that provided through interviews with personnel in the Air Quality Management Section and the public sector task analysis.

INTENDED AUDIENCE

Agency personnel performing the role of public information specialist. These persons can normally be assumed to have a college degree or at least two years of college training. They may be assumed to have a basic orientation to air pollution and agency activities (see Prerequisites). This background would include air pollution laws, effects, control devices, sampling and analysis techniques, plan/permit review, development of air quality programs and regulations, and agency organization.

COURSE GOALS

It is recommended that the goals of the course be to provide:

1. Ability to generate clear, complete, and concise public information statements including news releases, pamphlets, and the like.
2. Ability to serve as first source of information regarding agency functioning to the general public.

3. Ability to act as liaison between persons or groups desiring specific technical information and the source of such information within the agency.
4. Ability to act as public spokesman for the agency regarding general agency functioning. This includes making public appearances.
5. Ability to coordinate the public relations activities of the agency (e.g. scheduling and maintaining subject matter notes on public statements and appearances made by other agency personnel).

SKILL AND KNOWLEDGE COVERAGE

Skills and Knowledge	Teaching Level	Method/Media
Knowledge of the procedures for structuring a literature search and review effort to accomplish given objectives. This includes: 1. Use of key word systems 2. Information filing systems. 3. Development of review objectives	Familiarity	Lecture/ Readings/ Programmed Instruction/ Exercises
Knowledge of the accepted techniques for planning and presenting written or spoken communications, such as technical reports, public presentations, and formal correspondence	Familiarity	Lecture/ Readings/ Programmed Instruction/ Exercises
Knowledge of systematic approaches which are useful for problem solving and planning of work activities (e.g., the "systems" approach to design)	Familiarity	Lecture/ Readings/ Programmed Instruction/ Exercises
Knowledge of procedures for setting up and maintaining a file of public statements made by or about the agency. Such a file should facilitate identifying public response to agency activities and coordinating issuance of public statements	Exposure	Lecture/ Readings/ Programmed Instruction/ Exercises
Knowledge of the principles and procedures for selecting the media and format for presentation of information to the public. This	Familiarity	Lecture/ Readings/ Programmed Instruction

Skills and Knowledge	Teaching Level	Method/Media
involves knowledge of the types of media and format available and the relative advantages of each (including cost and production time factors)		
Knowledge of the sources for reference data and other basic materials required for preparation of a public information presentation (e.g., film libraries and periodicals)	Familiarity	Bibliography/ Exercises
General knowledge of the methods used by production personnel who will be involved in developing a public information presentation. This knowledge should be detailed enough that it is possible to define appropriate production criteria and to evaluate the efforts of production personnel. The production areas include: 1. Graphic arts 2. Printing 3. Film making 4. Publication design 5. Sound product (e.g., mixing)	Familiarity	Lecture/ Readings/ Programmed Instruction/ Exercises
Knowledge of the means by which public information can be distributed on a large scale and the methods by which materials can be incorporated in these media	Familiarity	Lecture/ Readings/ Programmed Instruction/ Exercises
Knowledge of the journalistic techniques and styles commonly used in preparation of public information	Familiarity	Lecture/ Readings/ Programmed Instruction/ Exercises
Knowledge of procedures for maintaining contact with the elements of the agency's working context which affect or are affected by its performance. These elements include: 1. The public sector 2. The industrial/commercial community 3. Local governmental and quasi-governmental bodies which	Exposure	Lecture/Group Discussion

Skills and Knowledge	Teaching Level	Method/Media
interface with agency activities (e.g., advisory board, variance board, public health department) 4. Relevant state or federal agencies The purpose of maintaining contact with the above is to monitor the agency's progress, limitations, and areas of possible extension of its activities		
Ability to quickly and accurately search literature resources for materials relevant to the literature search objectives. This is a process of successive approximations which should rapidly and accurately discard inappropriate materials and identify materials worthy of close scrutiny. Ultimately, this ability permits identification of the most useful materials	Coached Practice	Exercises
Ability to summarize and report the findings of a literature review in a manner which is responsive to the objectives of the review. For example, if the objective of the review is to identify the health effects of a particular contaminant, one means of presenting the findings is to describe each relevant study in terms of: 1. Effect reported or investigated 2. Exposure concentration 3. Exposure duration 4. Measurement methods and conditions 5. Reference	Coached Practice	Exercises
Ability to maximize positive payoff by selecting the most effective and least costly solution. Tasks requiring this ability often may have	Coached Practice	Exercises

Skills and Knowledge	Teaching Level	Method/Media
to be accomplished under a high degree of time stress and under public scrutiny		
Ability to make public presentations	Coached Practice	Practice Presentation
Ability to identify the information the public should have or requires to satisfy a particular need. This includes the ability to determine the appropriate level of detail for factual material. The level of detail selected will depend on factors including: 1. Audience reading level, interest, and relevant previous experience 2. Detail required to communicate the desired message or fact without confusing the issue 3. Availability of data. Information beyond a particular level of detail just may not be available	Coached Practice	Exercises
Ability to accurately transform and then clearly present technical content in a manner which effectively communicates to the public the appropriate concepts, facts, and images. For example, in describing a daily air pollution index generated by the agency, technical material concerning air monitoring equipment, pollutant characteristics, and criterion levels must be made understandable and interesting to the audience. In this example, and in most public information presentations, arousing and maintaining the audience's interest and concern for the technical material goes hand-in-hand with explaining the concepts clearly	Coached Practice	Exercises
Ability to communicate effectively and maintain working contacts with individuals and groups. Such groups or individuals include: 1. Citizen groups	Coached Practice	Group Exercises Involving Simulation of Typical Types of Interaction

Skills and Knowledge	Teaching Level	Method/Media
2. News media personnel. 3. Government officials (e.g., legislators, public policy makers) 4. Business and industrial groups 5. Air pollution control technical information sources (e.g., local experts)		
Ability to assist in development of a public information policy	Coached Practice	Group Discussion/ Exercises
Ability to discuss technical and policy issues with relevant agency personnel and other professionals for the purpose of securing needed facts and explanations to use fulfilling a request for information or in a public information presentation. For example, in developing a presentation on health effects of various pollutants, detailed discussions with agency chemists and public health scientists might be required to secure the appropriate information. It is necessary that the writer be able to get the required information accurately and quickly	Coached Practice	Group Exercise Involving Simulation of Typical Situations
Ability to select the media and format best suited to the characteristics of the material, audience, and objectives of a public information presentation. Constraints such as costs, time, etc., must be factored into this judgment	Coached Practice	Group Exercise Involving Simulation of Typical Types of Interaction
Ability to work with production specialists in generating a public information presentation. In these interactions, it is generally necessary to define desired product characteristics, evaluate suggestions, and supervise development of the product. Typically, interactions are required with: 1. Graphic arts personnel 2. Printers	Coached Practice	Group Exercise Involving Simulation of Typical Situations

Skills and Knowledge	Teaching Level	Method/Media
3. Film producers. 4. Media specialists (e.g., display designers)		
Ability to secure data required for a public information presentation using agency files, technical reports, and other relevant documentation	Coached Practice	Group Exercise Involving Simulation of Typical Situations
Ability to evaluate criticisms and suggestions responsive to a draft public information presentation and to use these comments to further develop the draft	Coached Practice	Exercises Involving Criticism of Trainee Produced Material

COURSE FREQUENCY

Schedule course at least twice to permit try-out and establish demand. Thereafter, schedule to satisfy anticipated demand.

COURSE LENGTH

The recommended course length is four days.

PREREQUISITES

Prospective trainees in 457 should have successfully completed 452 Principles and Practice of Air Pollution Control or a pretest covering the content of 452. The pretest should be self administered and self-evaluated.

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458 Air Pollution Administration

Air Quality Management Section

GENERAL COURSE DESCRIPTION

The 458 course, as recommended here, is a combination of three air pollution control agency management courses presently under development by APTI. These courses, and their proposed intents, are:

458 Air Pollution Administration I.

Intended to provide an understanding of federal air pollution-control requirements, and of the role of the state and local control programs on the overall control effort.

459 Air Pollution Administration II.

Intended to provide training in the fundamentals of staffing, as specifically applied to air pollution control agencies.

460 Air Pollution Administration III.

Intended to provide training in information systems, budgetary principles, and requirements of support programs.

The modified course 458 would be packaged in the form of self-instructional modules. They would utilize the audio-tape/booklet approach employed in 422-A, and other techniques including programmed texts, workbooks, and audiovisual presentations (e.g., super-8 cassettes and tape/slide sequences). Exercises could, in many cases, be designed to produce products useful to the agency (e.g., work procedures, budget estimates, personnel-evaluation guidance). Materials should be provided to the student's supervisor to assist in evaluating the student's progress and providing the student with feedback. The student can select modules appropriate to his management level and position responsibilities. Middle-level management trainees would be required to have a detailed knowledge of the organization, policies, functions, resources, long-range plans, and operating procedures of their agency. Exercises could be designed to help the trainees acquire this information from sources within their agencies.

INTENDED AUDIENCE

The intended audiences for the three courses are proposed as follows:

- 458 - new agency administrative-staff members having no experience in air pollution control
- 459 - middle-level supervisory personnel from control agencies
- 460 - Air Pollution Control Officers and other supervisory personnel involved in program planning and resource management

It is recommended that the intended audience be low- and middle-level management, and personnel in management-training positions. Trainees should be assumed to have professional competence in their respective technical areas as provided through college training and relevant APTI courses. They should also possess, as a minimum, basic knowledge concerning air pollution topics and agency functioning (see Prerequisites).

COURSE GOALS

Currently, 458 content-related goals are to provide:

1. Ability to define the responsibilities of each level of government in regard to the control of air pollution, and to quote the appropriate legislation for each level.
2. Ability to perform adequately in an assigned role in APEX (city or county politician, city or county planner, developer, industrialist, air pollution control officer, or concerned citizen).

The goals of 459 are to provide:

1. Ability to evaluate an agency's progress by developing and implementing a meaningful work evaluation program.
2. Ability to better utilize the resources of an agency.

The goals of 460 are to provide:

1. Knowledge of current and proposed federal regulations affecting agency operations.
2. Knowledge of available information systems in air pollution control.
3. Knowledge of grant and financial management practices under current EPA regulation.

It is recommended that the above goals be combined and integrated with the following goals (as a minimum):

1. Determination of manpower needs.
2. Development of a budget.
3. Development of work procedures.
4. Handling personnel problems.
5. Ability to recruit and select to fill manpower requirements.
6. Development and administration of a personnel-evaluation system.
7. Development of personnel training and professional-development programs.
8. Predicting work load, making work assignments, and coordinating the activities of subordinates.

SKILL AND KNOWLEDGE COVERAGE

Because 458, 459, and 460 are still under development, little information is available concerning the specific skills and knowledge covered in each. The list of skills and knowledge presented below is intended to be representative of those which ought to be included in the course, based on existing course information and the public-sector task-analysis data. All knowledge should be covered to the Familiarity level, and all skills to the level of Tutored Practice. The Method/Media previously described should be used.

Skills and Knowledge

1. Knowledge of procedures for developing and maintaining contact with the elements of the agency's working context that affect or are affected by its performance. These elements include:
    a. The public sector
    b. The industrial/commercial community
    c. Local governmental and quasi-governmental bodies which interface with agency activities (e.g., advisory board, variance board, public health department)
    d. Relevant state or federal agencies
2. Knowledge of ethical and effective methods for lobbying or negotiating with legislators, to speed up adoption of a desired regulation.
3. Ability to answer (in public) general and technical questions concerning air pollution-control technology and regulatory or control functions. The level of detail required for the response will vary as a function of the audience addressed. Such audiences can include:
    a. Legislative bodies or hearing boards
    b. Citizen groups
    c. Representatives of industry
    d. News media
4. Ability to communicate effectively in speech and writing with representatives of industry, citizen groups, or politicians, to accomplish functions including:
    a. Solicit criticisms, expectations, demands, and

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supporting technical information, relevant to development of new regulations or agency policy.

b. "Sell" the agency's position on the proposed regulation.

c. Negotiate a compromise version of the regulation which meets the requirements of the agency and satisfies the pressure groups.

d. Develop an episode-control system.

e. Aid in development of local control programs.

5. In interaction with industry or citizen groups, the ability to take a position based upon accurate assessment of the agency's capacity to perform its functions effectively. Also, the ability to identify "pressure" points which could be used to improve the agency's bargaining position. In the case of industry, such points include:

   a. Sensitivity to antitrust considerations

   b. Concern for the effects of public relations (i.e., "poor press")

   c. Knowledge that if an agreement is not reached with the agency, a more technically naive body (e.g., a state legislature) might formulate unreasonably stringent rules

6. Ability to effectively chair public or private meetings intended to generate questions, comments, criticisms, or recommended modification to proposed regulations or activities.

7. Knowledge of the procedures and materials used to apply for air pollution control program support from the federal government. Also, knowledge of the standard operating reports of periodic statements required by funding agencies.

8. Ability to prepare or coordinate preparation of grant-application materials.

9. Knowledge of systematic approaches which are useful for problem solving and planning of work activities (e.g., the "systems" approach to design). This includes:
    a. Knowledge of the state-of-the-art methods in program planning and budgeting (for example, Program Evaluation and Review Technique, Plan Programming Budgeting System).
    b. Knowledge of accepted procedures and techniques for planning the use of resources (personnel, material, and financial) to accomplish a specific work goal. This includes the ability to modify plans in response to contingencies (e.g., delays that affect the production schedule, caused by difficulty in obtaining required information).
10. Ability to interpret aagency policy in developing and planning agency activities. This skill involves the ability to discriminate whether or not planned activities are consistent with agency policy.
11. In establishing working policy and objectives for an agency or agency element, the ability to accurately identify:
    a. What its constituency (i.e., the public and industry) expects and is willing to accept.
    b. Whether the technological state-of-the-art has developed sufficiently to support proposed agency efforts.
12. Ability to systematically and effectively solve problems or make decisions. This general skill includes:
    a. Ability to accurately and objectively define the problem in terms of desirable outcome.
    b. Ability to accurately and completely identify the elements of the situation which affect selection or development of a solution.

- c. Ability to identify and describe potential solutions, or approaches to developing solutions.
- d. Ability to accurately define the relationships between these elements and the alternative solutions to the problem. This includes "trade-offs."
- e. Ability to set realistic priorities.
- f. Ability to estimate with a reasonable level of confidence the probabilities of successful solution for each alternative solution.
- g. Ability to maximize positive payoff by selecting the most effective and least costly solution.

13. Knowledge of the methods available for gathering the background information needed to develop new or modified regulations. Also, knowledge of the method for selecting the appropriate information-gathering method.

14. Knowledge of the published or unpublished sources of information available in a variety of areas relevant to air pollution-control and air-quality standards. Resources typically used in this task include:
    - a. The output of abstracting services
    - b. Relevant literature reviews
    - c. Journal annual indices
    - d. Proceedings of technical meetings
    - e. Agency files and publications

15. Ability to direct or perform the tasks required for gathering technical information needed for developing a draft regulation. The tasks to be performed may include:
    - a. Literature reviews
    - b. Empirical research
    - c. Survey of expert opinion
    - d. Review of the experience of agencies who have dealt with similar problems

16. Ability to design "paper-flow" systems to file, store, and retrieve necessary documentation. The system should be responsive to the quantity of materials to be handled, and to the agency's ability to utilize state-of-the-art techniques and equipment (e.g., microform, computers).

17. Ability to identify and describe existing conditions which signal the need for revision to existing regulations or agency activities. Such conditions may include:

    a. A new federal ambient air-quality standard is promulgated for a specific contaminant.

    b. Current emission standards are not achieving the desired effect on air quality.

    c. A breakthrough in air pollution-control technology has occurred, making a new generation of emission standards achievable.

    d. There has been an excessive number of single-chamber incinerator smoke violations.

    e. Scientific evidence has been published, showing significant health effects due to a contaminant which is currently emitted without being controlled by regulations.

    f. The penalty for a specific violation does not appear to be having a significant deterrent effect.

18. Knowledge of principles and procedures for organizing an operational or task-oriented group.

19. Ability to direct or coordinate non-routine projects which require the type of skills and knowledge available within the staff of a specific operational group (e.g., inspection, plan-review groups). To direct such projects, the Director frequently must:

    a. Develop project objectives from brief statements of the general purpose of the projects

    b. Make assignments

  - c. Prepare schedules
  - d. Supervise production
  - e. Present or coordinate presentation of results

20. Background knowledge sufficient to support evaluation and implementation of new techniques in areas including:
    - a. Personnel management
    - b. Organizational structure
    - c. Program and budgetary planning
    - d. Computerized data-filing-and-acquisition systems
21. Ability to direct or coordinate development and implementation of policies and procedures governing:
    - a. Purchasing and inventory management
    - b. Personnel management
    - c. Financial management (e.g., budget planning and implementation)
22. Knowledge of principles and procedures for designing, developing, and implementing a personnel performance-evaluation system.
23. Ability to develop, or assist in the development of, a personnel performance-evaluation system, and the ability to administer such a system effectively. Development of the system includes:
    - a. Ability to identify appropriate performance dimensions. Such dimensions should be observable and, as much as possible, open to objective evaluation.
    - b. Ability to develop a review procedure and working materials.
    - c. Ability to provide constructive feedback to staff members in a manner which will foster continuing personnel development.

24. Ability to evaluate the quantity and quality of work produced by the staff, and discriminate acceptable from unacceptable performance. This skill assumes the ability to develop or use criteria of performance acceptability.

25. Knowledge of principles and procedures used for identifying personnel requirements and selection criteria, and for using them in a selection program.

26. Knowledge of accepted procedures and techniques for developing job specifications and job-classification schemes.

27. Ability to develop, or assist in development of, job specifications and selection criteria which can be used in a personnel-recruitment program.

28. Knowledge of principles and procedures for identifying training requirements, preparing training objectives, and developing a program to achieve the objectives.

29. Ability to identify and describe training requirements for information and skill, in order to determine content areas to be covered in a program. This requires:

    a. Identification and description of the tasks to be performed by the trainee on the job and which are to be covered by the course.

    b. Identification of the skills and knowledge required to effectively perform those tasks.

    c. Identification of those required skills and knowledge not currently held by the trainees, and which are, therefore, reasonable content areas for the course to attack.

30. Knowledge of accepted procedures and techniques in personnel relations and personnel problem solving.

31. Ability to counsel agency personnel holding grievances, and to work with union officials in cases in which they are involved.

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32. Knowledge of basic accounting methods, such as preparation of trial balance and financial statements (using general journal and general ledger methods).

33. Knowledge of procedures for developing and administering employee-benefit programs, including vacation leave, insurance plans, sick leave, etc.

34. Ability to develop and coordinate implementation of equipment-accountability and inventory-control systems.

35. Ability to coordinate systems for monitoring and controlling agency expenditures, within the budgetary constraints.

36. Ability to forecast the resources needed by a working group in order to prepare the annual budget. This skill encompasses component abilities, including:

    a. Anticipate the specific types of services to be performed during the next period.

    b. Project the work load over the period. To do this, the planner must identify the critical variables (e.g., population growth, economic conditions) and transform them into a factor for use in deriving anticipated work load. Be careful not to base projections too heavily on current work loads. Consider the effect of new regulations and procedures on work load.

    c. Determine if current resources will be capable of handling the anticipated work load. Identify the modifications required in current resource levels to cover anticipated work load.

COURSE FREQUENCY

The course should be made available to the agencies as required on a lend/lease basis, directly from APTI or through the Regional Training Centers.

COURSE LENGTH

The time required to take the course would depend upon the trainee. A mean time for completing the course might be 80 hours including exercises, but trainees could take selected modules or groups of modules to suit their immediate requirements. A single module should be designed to require one to two hours for completion.

PREREQUISITES

The prerequisites for 458 would be 452 Principles and Practice in Air Pollution Control. However, since the course is administered within the agency, no control can be exercised over the actual prerequisites of the trainees taking the course.

2 Air Quality Program Development

Air Quality Management Section

GENERAL COURSE DESCRIPTION

The intent of this course is to provide the necessary background to permit the student to develop, or supervise the development of, fair, enforceable, understandable, attainable regulations. A second intent is to enable the student to develop practical and effective agency programs for achieving air quality standards. The course would be packaged, modularized, and self-instructional. It would include simulation exercises designed to give the trainee practice in developing regulations/programs.

INTENDED AUDIENCE

The course is intended for agency personnel responsible for developing or modifying regulations and air quality programs. These persons are assumed to have professional background in engineering, chemistry, meteorology, or law. They are likely to have management positions within the agency. They are further assumed to possess a knowledge of air pollution topics and agency functioning equivalent to 452, plus a year or more agency professional experience.

COURSE GOALS

The goals of the course are to enable the trainee to:

1. Identify and interpret the need for new and modified regulations and programs.
2. Collect the information necessary for planning and decision-making in this area.
3. Coordinate with agency technical experts (lawyers, top-level agency management, chemists, engineers, meteorologists) in achieving the intent of the regulation/program.

4. Coordinate input from the community at large (e.g., affected industries, public-interest groups, general public), including holding meetings and public hearings.
5. Develop the wording for the regulation and detailed documentation of the program.
6. Oversee the process of enacting the regulation/program.

SKILL AND KNOWLEDGE COVERAGE

The representative skills and knowledge recommended for the course are listed below. A knowledge can be assumed to be covered at the Familiarity level; skills are covered to the level of Tutored Practice. The Methods/Media to be employed include: (1) audiotape/booklet combinations (as employed in 422-A), (2) films (e.g., super-8 cassettes), (3) slide-tape, (4) programmed instruction readings, (5) problems, and (6) simulation exercises involving a data base description of a typical community/agency situation.

Skills and Knowledge

1. Ability to identify and describe existing conditions which signal the need for revision to existing regulations or agency activities. Such conditions may include:
    a. A new federal ambient air quality standard is promulgated for a specific contaminant.
    b. Current emission standards are not achieving the desired effect on air quality.
    c. A breakthrough in air pollution control technology has occurred, making a new generation of emission standards achievable.
    d. There has been an excessive number of single-chamber incinerator smoke violations.

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   e. Scientific evidence has been published showing significant health effects, due to a contaminant which is currently emitted without being controlled by regulations.

   f. The penalty for a specific violation does not appear to be having a significant deterrent effect.

2. Knowledge of state and federal regulations and standards which suggest or prescribe the characteristics of local control programs.

3. Ability to interpret existing state or federal legislation and regulations, relevant to the state's possible role in developing local air pollution control programs.

4. Ability to coordinate a systematic effort to determine the requirements for a local program. This ability includes skills required to:

   a. Design an adequate study of the pollution problems of the area.

   b. Supervise collection, analysis, and presentation of the data from the requirements study.

   c. Evaluate the findings and make realistic conclusions about the type of program that is required.

5. Ability to direct or perform the tasks required in gathering technical information that is needed for developing a draft regulation. The tasks to be performed may include:

   a. Literature reviews

   b. Empirical research

   c. Survey of expert opinion

   d. Review of the experiences of agencies which have dealt with similar problems

6. Knowledge of the procedures for structuring a literature-search-and-review effort, to accomplish given objectives. This includes:
    a. Use of key word systems
    b. Information filing systems
    c. Development of review objectives.
7. Ability to identify the specific background information which must be gathered before a new or modified regulation can be drafted. The types of required data may include:
    a. What emission standard is needed to produce a specific ambient air quality level for a specific contaminant. Consideration will have to be given to diffusion modeling, emission inventory, successful applications at other agencies, local background levels, and special cases such as extra-tall stacks.
    b. What other agencies are doing to enforce their regulations.
    c. What design characteristics can be standardized in a class of control devices (e.g., large-capacity incinerators) to assure reduced emissions.
    d. What advantages for handling emergencies would accrue as a result of extending the boundaries of agency coverage to new areas or air basins.
    e. What is the current state-of-the-art in control of emissions from coke quenching? What emission standards are feasible and enforceable?
8. Knowledge of the published/unpublished sources of information available in a variety of areas relevant to air pollution control and air quality standards. Resources typically used in this task include:
    a. The output of abstracting services

   b. Relevant literature reviews
   c. Journal annual indices
   d. Proceedings of technical meetings
   e. Agency files and publications

9. Ability to interpret the general objectives of a literature survey, in terms of the specific types of data to be reviewed and summarized. For example, what type of data should be reviewed to support developments of new air quality standards?

10. Ability to progressively refine literature-search information requirements, to accurately reflect data and insights acquired as the review progresses toward its objectives.

11. Ability to evaluate the validity, reliability, and relevance of the findings and opinions reported in technical and scientific literature. Some of the problem areas which must be carefully scrutinized and evaluated include:

    a. In experimental research, was the experimental design adequate? For example, were the controls appropriate? Were the proper statistical methods applied?

    b. Were assumptions reasonable, given what was known about the topic?

    c. Were the data presented appropriately? For example, do the graphs agree with the findings given elsewhere in the report?

    d. Do the findings agree with related findings in other studies?

    e. Were the general conclusions well-supported by the reported results, and by the findings and conclusions of other authors?

12. Ability to design "paper-flow" systems to handle and store necessary documentation. The system should be responsive

to the quantity of materials to be handled and to the agency's ability to utilize state-of-the-art techniques and equipment (e.g., microform, computers).

13. Ability to transform (e.g., using statistical or logical methods) reported findings into a form which is more directly relevant to the objectives of a literature review.

14. Ability to summarize and report the findings of a literature review in a manner which is responsive to the objectives of the review. For example, if the objective of the review is to identify the health effects of a particular contaminant, one means of presenting the findings is to describe each relevant study in terms of:

    a. Effect reported or investigated

    b. Exposure concentration

    c. Exposure duration

    d. Measurement methods and conditions

    e. Reference

15. Ability to identify those general characteristics of a new or revised regulation which provide a means for correcting the conditions that originally signaled the need for new or modified regulations. Such general types of additions or modifications could include:

    a. New or modified emission standards.

    b. Modification in an existing agency procedure (e.g., a change in the permit-system fee schedule).

    c. Inclusion in the regulations of such references as nomographs and data tables, to enable potential sources to, in part, evaluate their own emission levels.

    d. Revision of a regulation which is apparently vague, and therefore difficult to interpret and enforce.

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16. Ability to select from alternative control and regulatory activities those functions appropriate to the needs of, and restrictions on, local programs.

17. Ability to judge current local political/economic conditions, and react to them accordingly in developing agency programs or regulations.

18. Knowledge of the air pollution control policies and programs of similar agencies, and the effects those policies and programs have had on local pollution conditions, industrial cooperation, citizen support, etc.

19. Knowledge of the relative strengths/weaknesses of alternative control-and-regulatory activities, programs, and policies which an agency can deploy under given operating conditions.

20. Knowledge of the alternate enforcement actions which the agency can take for a given type of violation, and knowledge of criteria, priorities, standards, and precedents used to select the appropriate enforcement activity.

21. Ability to evaluate the potential effectiveness of the proposed local programs. This skill includes ability to identify and correct loopholes in the law or regulations.

22. Ability to recognize areas where a proposed local program can be cut to an acceptable cost level, while minimizing the resultant reduction in capability.

23. Ability to gather appropriate background data, and then estimate the resources needed to administer a proposed local program.

24. Ability to work with attorneys to define the agency's authority, responsibility, and jurisdiction, by interpreting the relevant enabling legislation and local air pollution-control regulations.

25. Ability to interact with attorneys in developing acceptable language and content for proposed regulations, modifications to current regulations, and in developing model ordinances.

This requires skill in communicating the needs of the agency to the attorney, and in helping him to evaluate the degree to which the legally acceptable form satisfies the original intent of the effort.

26. Ability to communicate effectively in speech and writing with representatives of industry, citizen groups, or politicians, to accomplish functions including:
    a. Solicit criticisms, expectations, demands, and supporting technical information relevant to development of new regulations or agency policy.
    b. "Sell" the agency's position on the proposed regulation.
    c. Negotiate a compromise version of the regulation which meets the requirements of the agency and satisfies the pressure groups.
    d. Develop an episode control system.
    e. Aid in development of local control program.
27. Ability to assist in the development and implementation of a program to lobby for adoption of a proposed regulation. Such programs can include:
    a. Public information presentations.
    b. Personal contacts and discussions with rule makers, industrial representatives, citizen groups, etc.
    c. Negotiation and compromise.

COURSE FREQUENCY

The course should be made available to the agencies as required on a lend-lease basis, directly from APTI or through the Regional Training centers.

COURSE LENGTH

The time required to complete the course would vary with the trainee. A mean time to complete the total course with exercises would probably be about twenty-five hours. A single module should be designed to require one to two hours to complete.

PREREQUISITES

There are no formal prerequisites for this course, although prospective trainees should be provided with a detailed description of the assumed training background (see Intended Audience).

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3 Presentation of Expert Testimony

Air Quality Management Section

GENERAL COURSE DESCRIPTION

This course is proposed as an accompanying presentation for the current courses which address the topic of being an expert witness. The current courses can then drop their coverage, and utilize this brief course, as appropriate. In this way, (1) overlaps in coverage are avoided for students who take several of these courses, (2) all students receive training to the same scope and depth, and (3) existing courses can utilize all their time to present their main topics.

Courses currently providing training in being an expert witness and their coverage are as follows:

1. 452 Principles and Practice of Air Pollution Control. This course devotes seven hours to the topic of being an expert witness. An introductory session (two hours) presents: (1) rules for good courtroom demeanor, (2) ways of establishing one's identity as an expert witness, (3) ways in which a witness is summoned to appear, and (4) distinctions among hearsay, opinion evidence, and facts obtained by sense perception. Following this introduction, small groups of students prepare a case for participation in a mock trial, present their case in a role-play setting, and participate in a follow-up critique.

2. 439 Evaluation of Visible Emissions. This course provides training which should enable students to: (a) identify 8 of the 10 criteria for being an expert witness, (b) list 5 of the 8 rules for behavior on the witness stand, and (c) cite the legal precedents set in the California appeal cases concerning visible-emission regulations. To meet the objective implied above, the instructor shows the 16mm film, "The Role of a Witness." The film has a running time of 45 minutes,

and includes two breaks where the film can be stopped to permit instructor remarks.

3. 444 Air Pollution Field Enforcement. The objective for this course include knowledge of what is expected of an expert witness, and ability to be an expert witness in court. A period of 2 hours is scheduled for viewing the previously mentioned film, "The Role of a Witness", plus accompanying lecture-discussion.

Proposed Course 3 Presentation of Expert Testimony intends to combine the goals and approaches into a single course. This course is for use in conjunction with the existing courses, or as an independent entity for presentation upon request. Course elements can also be packaged for use in the field.

INTENDED AUDIENCE

All professional personnel, agency or private-sector, who are concerned with participation in legal hearings of air pollution cases.

COURSE GOALS

To provide:

1. Knowledge of the general characteristics of good legal evidence, and general guidance in how to collect it.
2. Knowledge of the characteristics of an expert witness, and how to establish credibility.
3. Knowledge of proper witness demeanor--what to do and avoid doing while testifying.
4. Guidance to assist the student in collecting, critiquing, and organizing evidence, and in preparing testimony for the trial or hearing for which the student is immediately concerned.
5. A format for role-playing situations that would provide practice in being an expert witness.
6. Elements of trial and administrative hearing procedures.

SKILL AND KNOWLEDGE COVERAGE

The following is a representative list based on analysis of existing courses and both public- and private-sector task analyses. The final list should be made by a subject-matter expert to reflect state-of-the-art and to ensure completeness.

The Teaching Level for the knowledge items is Familiarity. The skill (item 4 in the following list) is an optional course element and, if included, should provide practice to the Tutored Practice level. Method/Media should include use of the film, "The Role of the Witness"; lecture-discussion; student exercises; feedback critique; and, where skill development is provided, role play and courtroom simulation.

Skills and Knowledge

1. Knowledge of the technical information usually requested of a witness to qualify him as an expert. This technical information includes:
   a. Rules and regulations relevant to the case.
   b. The facts of the case which comprise the witness's testimony (e.g., technical data, research findings).
   c. The duties of an air pollution inspector, engineer, or whatever role the witness may play.
2. Knowledge of the procedure for preparing a presentation to be given before a court, hearing board, or other legal or quasi-legal body.
3. Knowledge of the appropriate dress and decorum for presentation before a court, hearing board, or other legal or quasi-legal body.
4. Ability to successfully fill the role of expert witness in a mock trial situation.
5. Knowledge of what constitutes legally acceptable evidence, and the ability to critique the adequacy of existing evidence (and, if possible, to correct shortcomings in it).

6. Knowledge of the role of agency legal counsel in preparation for a hearing, and general guidelines to facilitate communication and cooperation between agency personnel and counsel in making such preparation.

COURSE FREQUENCY

Schedule to immediately follow presentation of 452, 439, or 444, and upon request.

COURSE LENGTH

One day, although the course could be extended to two days with more time provided for courtroom simulation.

PREREQUISITES

None

APPENDIX

DETERMINATION OF PRIVATE-SECTOR AIR POLLUTION CONTROL-RELEVANT SKILLS AND KNOWLEDGE, TASKS, OCCUPATIONAL CATEGORIES, AND TRAINING NEEDS

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APPENDIX

DETERMINATION OF PRIVATE-SECTOR AIR POLLUTION CONTROL-RELEVANT SKILLS AND KNOWLEDGE, TASKS, OCCUPATIONAL CATEGORIES, AND TRAINING NEEDS

The private-sector task analysis performed in Phase I of the present project had as its basic objective the detailed analysis of tasks judged, *a priori*, to be air pollution control-relevant. The approach employed was to divide the private sector into various elements having differing air pollution roles (e.g., as sources of pollution, as manufacturers of control equipment, etc.) A rational analysis was then performed, based on the best available knowledge, to identify the air pollution-related activities engaged in by the various private-sector elements. Those activities judged most likely to have APTI-relevant training needs were selected by ASA and APTI for inclusion in the task analysis.

Data was then collected from the private-sector elements, with the aim of completely describing the major skills and knowledge required to effectively perform the selected activities, without regard for their air pollution-training relevance. A detailed description of the conduct and results of the private-sector task analysis can be found in the project interim report[*].

Before the private-sector task analysis data could be used in the development of the APTI course recommendations, the data had to be further analyzed to define air pollution control-relevant skills and knowledge and tasks. Based on this information, relevant occupational categories were developed, and the training needs of these occupational categories were determined. The analysis proceeded in three steps:

1. Air pollution control-relevant skill and knowledge determination.

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[*] Dueker, R. L., Rifkin, K. I., & Covert, A. W. *Analysis of air pollution control-related tasks in the private sector. Volume I: Conduct of the analysis. Volume II: Results of the analysis*. Valencia, Pa.: Applied Science Associates, Inc., March 1973.

2. Task determination
3. Definition of occupational categories/training needs determination.

Air Pollution Control-Relevant Skill and Knowledge Determination

In order to determine air pollution-relevant skills and knowledge in the private sector, it was first necessary to develop the criteria for selection. Four selection criteria were determined. To be selected as air pollution-relevant, a skill or knowledge had to be:

1. Directly related to air pollution subject areas (e.g., legal aspects, control devices, analysis of pollutants). Basic skills and knowledge (e.g., basic engineering concepts, communication skills) were not included, unless they were known to be already incorporated in current APTI training.
2. General across industrial processes. Skills and knowledge specific to a single industrial process (e.g., the manufacture of paint) were not included.
3. Not normally included in the formal or professional training of the occupational category. For example, in a task normally performed by engineers, knowledge of basic mechanical principles would not be included because it is assumed that this knowledge would have been provided as part of the engineers' college background.
4. Consistent with the type of training provided by APTI and its perceived mission. Thus, skills and knowledge for sales or process equipment operation would not be included, although both are related to the control of pollution.

Each skill and knowledge statement in the task analysis was examined against these criteria, and judged "relevant" or "non-relevant."

Task Determination

Once relevant skills and knowledge had been determined, it was relatively easy to judge, at least roughly, the air pollution relevance of each task defined in the task analysis. First, a count was made of the relevant skill and knowledge statements included in each task. Then, percentages of air pollution-relevant skills and knowledge to total skills and knowledge were calculated. The resulting tabulation is given in Table A-1. The table shows raw counts and percentages for skills, knowledge, and the sum of both, for each function and for individual tasks within functions. It is apparent that the Source Testing and Air Monitoring functions contained by far the heaviest concentration of air pollution-relevant skills and knowledge (they comprise 98 percent of the total number of skills and knowledge listed within the function). By contrast, the Sales and Service of a Product Line function is nearly devoid of relevant skills and knowledge (four percent).

In determining course recommendations, a proportionally greater effort would be made to accommodate the training requirements of the more relevant tasks. In judging the degree to which each task was air pollution-relevant for the purpose of determining recommendations, the data in the table would be employed in conjunction with reexamination of the individual skill and knowledge statements.

Definition of Occupational Categories/ Training-Needs Determination

The final step in the analysis was to define private-sector occupational categories. This was done in a manner parallel to the occupational categories defined for the public sector (see the public-sector task

Table A-1

Air Pollution-Relevant Skills and Knowledge by Task and Function

FUNCTIONS AND INDIVIDUAL TASKS WITHIN FUNCTIONS	SKILLS		KNOWLEDGE		TOTAL	
	Number	Percent	Number	Percent	Number	Percent
PLANNING AN AIR POLLUTION PROGRAM						
Develop Channels of Air Pollution-Relevant Information	1	25%	3	50%	4	40%
Participate in Formulating Legislation and Regulations	2	33%	2	50%	4	40%
Plan a Control Program	12	38%	18	67%	30	63%
Develop an Episode Control Plan	8	73%	3	60%	11	69%
Function Total	23	55%	26	62%	49	58%
PRODUCT AND CONTROL SYSTEM DESIGN						
Design of a Control System	2	25%	5	100%	7	54%
Oversee Construction and Installation of the System	1	11%	2	25%	3	18%
Design of an Air Monitoring Device	0	0%	4	33%	4	22%
Function Total	3	13%	11	44%	14	29%
OPERATION AND MAINTENANCE OF A CONTROL SYSTEM						
Supervise Operation of a Control System	2	20%	2	40%	4	27%
Supervise Maintenance of a Control System	4	22%	2	22%	6	22%
Function Total	6	21%	4	29%	10	24%
DEVELOPMENT OF OPERATION AND MAINTENANCE DOCUMENTATION						
Development of Documentation	2	28%	3	33%	5	31%
Function Total	2	28%	3	33%	5	31%

Table A-1 (Continued)

FUNCTIONS AND INDIVIDUAL TASKS WITHIN FUNCTIONS	SKILLS		KNOWLEDGE		TOTAL	
	Number	Percent	Number	Percent	Number	Percent
SOURCE TESTING AND AIR MONITORING						
Planning and Supervising a Stack Test	17	89%	25	100%	42	95%
Performing a Stack Test	7	100%	15	100%	22	100%
Determination of Oxides of Nitrogen Using the Phenoldisulfonic Acid Method	10	100%	11	100%	2	100%
Determination of Sulfur Dioxide Using the Hydrogen Peroxide Method	9	100%	10	100%	19	100%
Determination of Oxidants Concentration in the Atmosphere Using the Neutral Buffered Potassium Iodide Method	10	100%	14	100%	24	100%
Function Total	53	96%	75	100%	128	98%
SALES AND SERVICE OF A PRODUCT LINE						
Supervision of a Sales Department	1	5%	1	5%	2	5%
Supervision of a Service Department	0	0%	1	6%	1	3%
Training of Sales and Service Personnel	0	0%	0	0%	0	0%
Function Total	1	2%	2	5%	3	4%

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analysis report for a listing of these occupational categories[*]). The definition of private-sector occupational categories was facilitated by the fact that the necessary data already existed in the task-analysis data base. The background data on the education and experience of persons interviewed during the data collection was analyzed, and a generalized set of category descriptions was defined. These covered the range of occupational types performing the air pollution tasks specified in the task analysis. Table A-2 lists and describes the private-sector occupational categories.

The air pollution relevance of each occupational category was determined by summing the air pollution-relevant skills and knowledge connected with the tasks typically performed by the category. A count of relevant skills and knowledge by occupational category is provided in Table A-3. It is apparent from the table that Chemists and Chemistry Laboratory Technicians have the greatest training need, from the viewpoint of air pollution-relevant skills and knowledge. As with the analysis of relevant tasks, the tabulation in Table A-3 was used in making judgments concerning the importance of modifying APTI courses to meet the training needs of a given private-sector occupational category.

As a final step in the analysis, the skill and knowledge statements making up the air pollution-relevant training needs for each private-sector occupational category were compiled. These training-needs descriptions were used as a data source for the derivation of recommendations, as described in this text.

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[*] Rifkin, K. I., Dueker, R. L., Diggins, W. F., Foss, F. C., & Senew, M. Task analysis of state and local air pollution control agencies and development of staffing guidelines. Valencia, Pa.: Applied Science Associates, Inc., July 1972, pp 42-74.

Table A-2

Private-Sector Occupational Categories

Air Pollution Staff Head

Responsibilities: Supervises corporate staff performing high-level company-wide planning, design, and plant air pollution-support tasks

Education: B.S. or M.S. in Mechanical or Chemical Engineering, or (occasionally) Business Administration

Experience: Five or more years in company air pollution work

Air Pollution Staff Member

Responsibilities: Performs as member of corporate air pollution staff

Education: B.S. in Mechanical or Chemical Engineering; receives air pollution training on-the-job

Experience: Often a new graduate

Plant Manager

Responsibilities: Directly responsible for air pollution-related activities (e.g., variances, episode control, control-system planning) at the plant level

Education: Usually a B.S. in an engineering specialty (Mechanical or Chemical) relevant to the plant process

Experience: Five or more years in plant operations, often none in air pollution

Table A-2 (Continued)

Control-System Design Engineer

Responsibilities: Responsible for design, installation, and start-up of control systems

Education: B.S. in Mechanical or Chemical Engineering; learns relevant control technology on-the-job

Experience: Several years with process or process equipment

Monitoring-System Design Engineer

Responsibilities: Responsible for design and testing of prototype monitoring instruments

Education: B.S. in Chemical or Electrical Engineering

Experience: Several years' design experience

Operation/Maintenance Foreman

Responsibilities: Supervises line operations or maintenance

Education: High School, occasionally a B.S.; rarely any air pollution training

Experience: Several years' line experience

Documentation Specialist

Responsibilities: Prepares operation and maintenance documentation for incinerators, boilers, control devices, or monitoring instruments

Education: B.S. in Engineering or English; gains familiarity with equipment and existing documentation on-the-job

Experience: Variable

Table A-2 (Continued)

Chemist

Responsibilities: Performs, or supervises the performance of, sampling and laboratory analysis of pollutants (including stack testing)

Education: B.S. or higher in Chemistry; learns air pollution-related techniques on-the-job

Experience: Variable, may be recent graduate

Chemistry Laboratory Technician

Responsibilities: Performs sampling and analysis under supervision of a Chemist

Education: High School, and sometimes special technical training

Experience: Variable, may be a recent graduate

Sales/Service Department Supervisor

Responsibilities: Supervises the operation of a department to sell or service incinerators, boilers, control equipment, or monitoring instrumentation

Education: Usually a B.S. in Mechanical or Chemical Engineering

Experience: Several years' company and product-line experience

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Table A-3

Air Pollution-Relevant Skills and Knowledge by Occupational Category

	Skills	Knowledge
Air Pollution Staff Head	11	19
Air Pollution Staff Member	10	14
Plant Manager	10	16
Control-System Design Engineer	3	7
Monitoring-System Design Engineer	0	4
Operation/Maintenance Foreman	4	2
Documentation Specialist	2	3
Chemist	17	27
Chemistry Laboratory Technician	19	29
Sales/Service Department Supervisor	1	2